THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVII. No. 1729.] LONDON, JUNE 30, 1896. [48TH YEAR. PRICE 6d.

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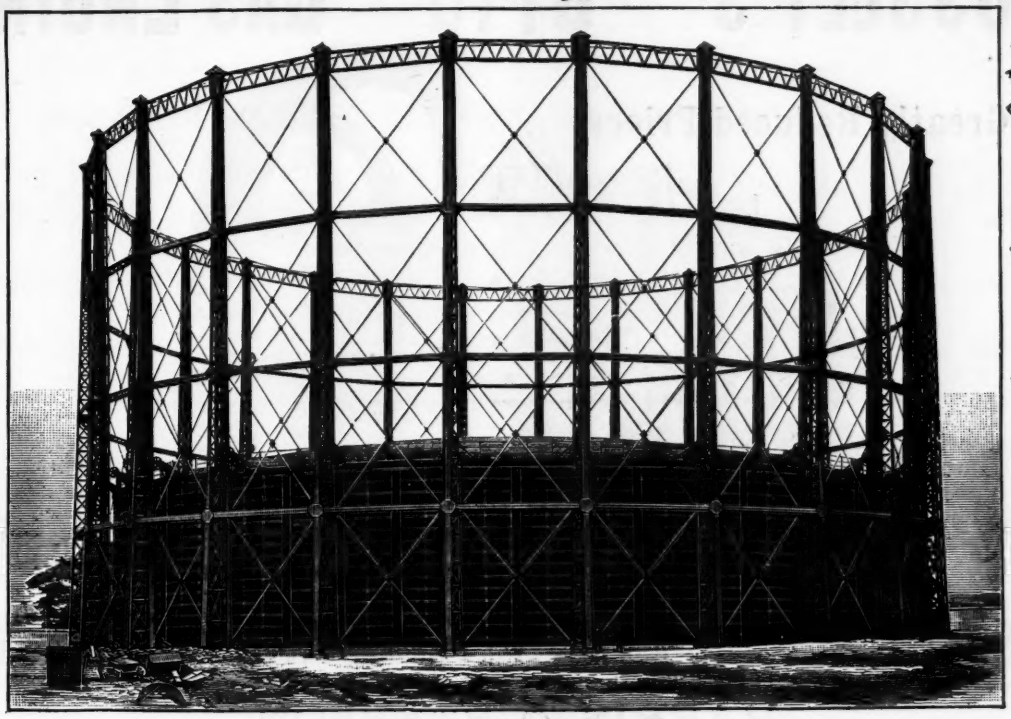

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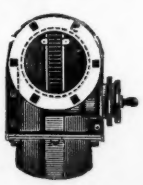

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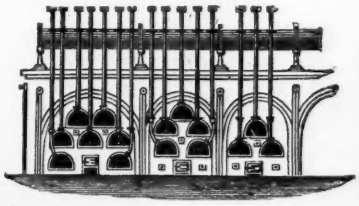

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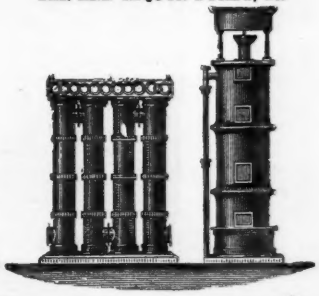

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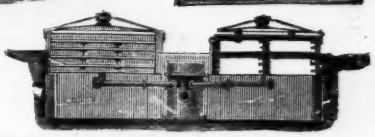

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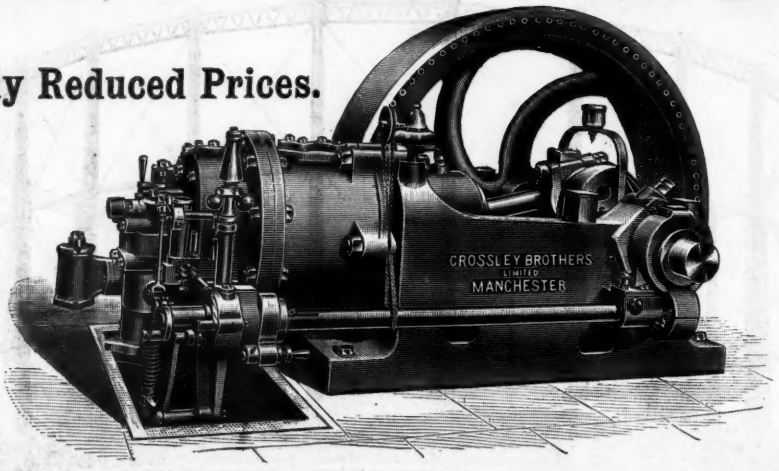

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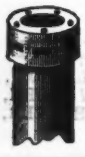

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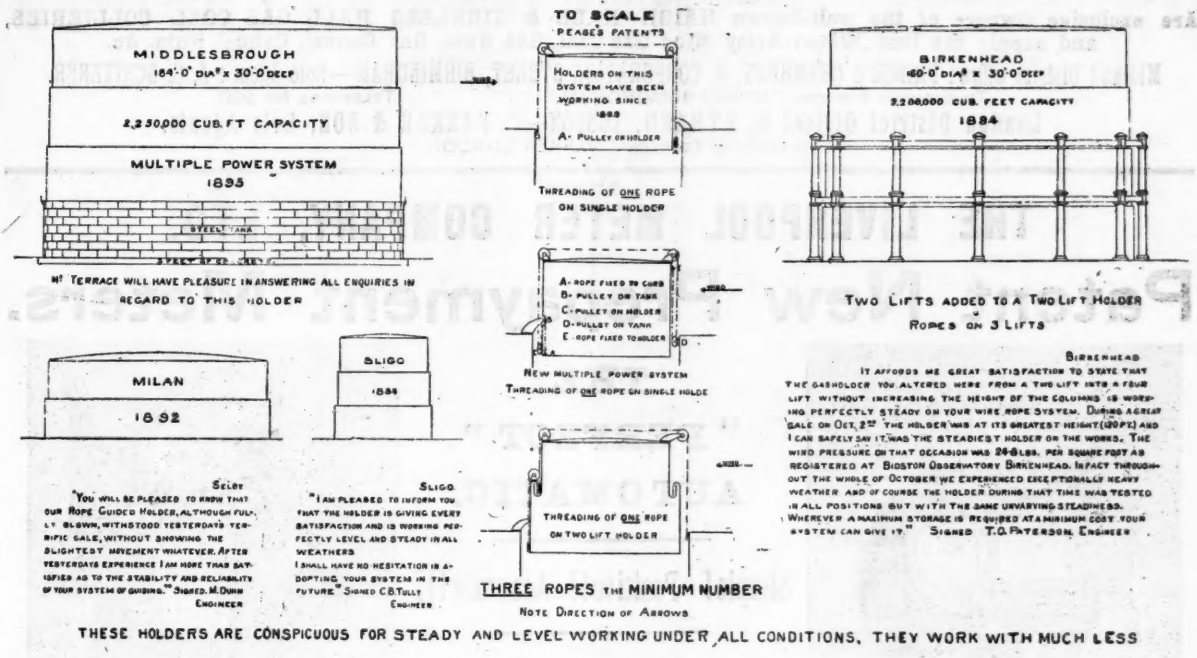

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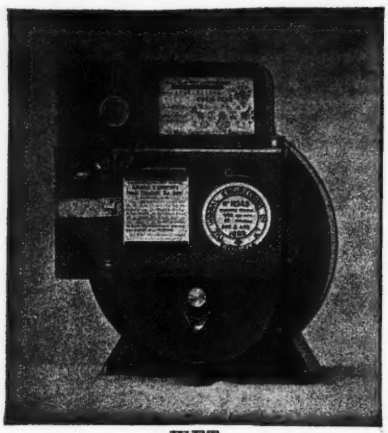

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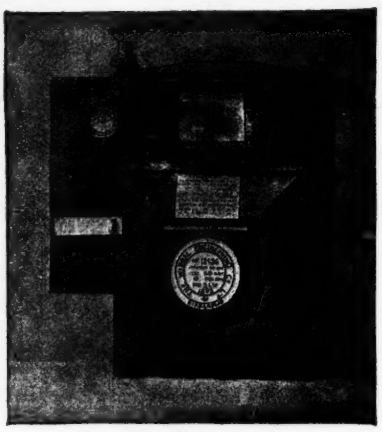

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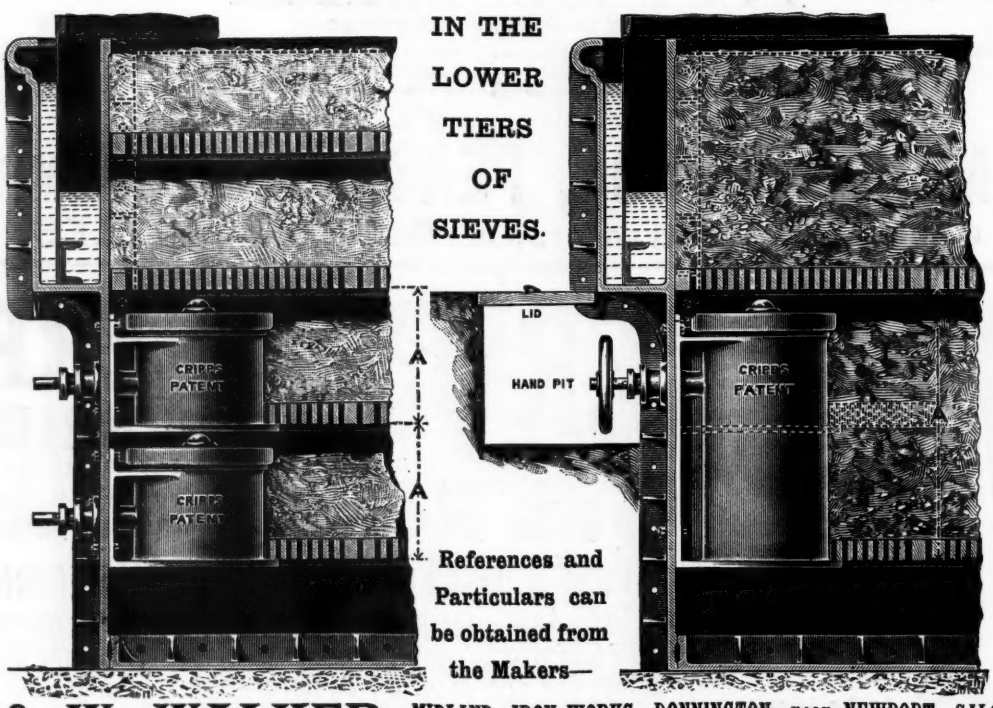

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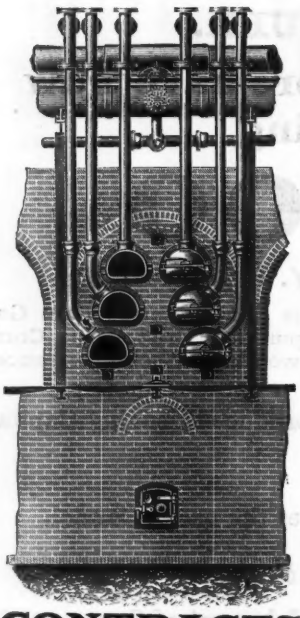

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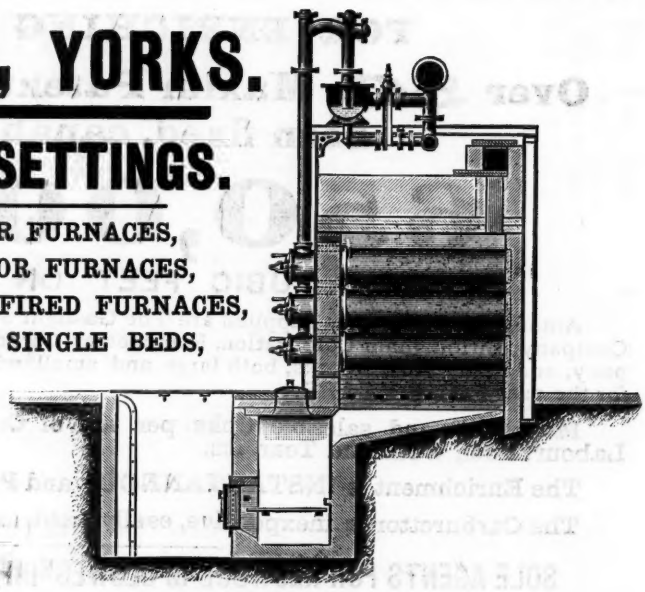

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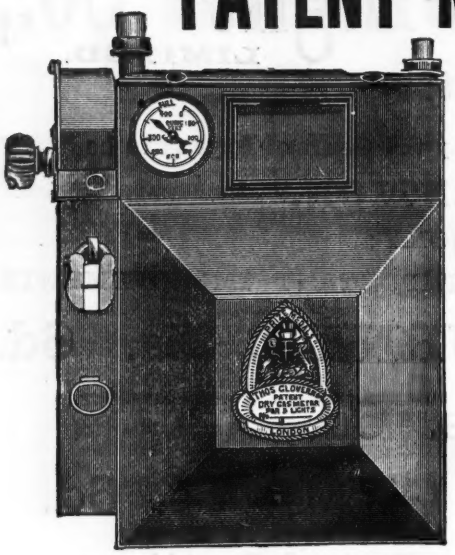

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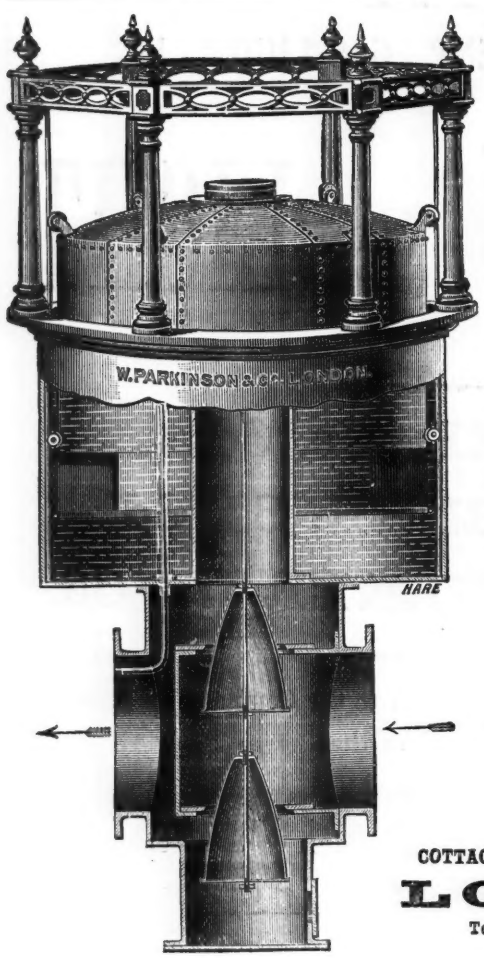

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[See also Advt. p. 1500.

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EDITORIAL NOTES.

The Legal Position of the Incandescent Gas-Light Company.

THE De Mare appeal against the judgment of Mr. Justice Wills in the great incandescent gas-light patent case was dismissed unanimously last Wednesday, with costs, by the Court of Appeal composed of the Master of the Rolls, Lord Justice Kay, and Lord Justice A. L. Smith. A full report of the proceedings is given elsewhere. In face of this result, the losers will hardly take any further steps with the forlorn hope of retrieving their fortunes; so that this chapter of the record of a most important and interesting litigation may be safely regarded as closed—leaving the Welsbach interest on the highest possible pinnacle of legal security, as it had already attained an unprecedented technical triumph, and an extraordinary commercial success. The history of the incandescent gas-light will stand in the records of patented inventions as a bright example of the results attainable when science, genius, perseverance, technical skill, and commercial ability combine to give the world something that is wanted, wanted largely, and cannot be had by other means. The immediate legal victory of the Welsbach interest is a notable reward of the masterly direction of a lawsuit which was not stinted of the aid that forensic ability, expert testimony, and ample resources can afford in support of a case intrinsically strong; but it is also impossible to regard it otherwise than as an endorsement of the popular view of the rights of the matter. There never was a marketable, usable incandescent gas-light until Dr. Auer von Welsbach made one; and he and those associated with him in the protection, exploitation, and development of his great invention are to be congratulated upon the fortune that has waited upon their work and enterprise. It is not so often that the true and original inventor of a successful novelty of any kind reaps the reward of his merit, either in the shape of fame or money, that one need begrudge Dr. Auer and his associates hearty felicitations on the kindness with which Fate has treated him and them.

There are many aspects from which the Welsbach light may be regarded; but we cannot attempt to discuss more than one—that which it presents from the standpoint of those who are concerned to maintain the stability, and further the continuance in prosperity, of the industry of illuminating gas supply throughout the world. We do not believe that either the one or the other condition is bound up with the popularity of the incandescent gas-burner, to say nothing of the validity of the Welsbach patent. The gas industry did very well before the incandescent burner was ever heard of; and it is the magnitude and universal appreciation of the essential convenience of gas lighting that gave to Dr. Auer his opportunity, rather than his ingenuity which has hitherto advanced the industry. The benefit, let us say, is mutual. What Dr. Auer undoubtedly did for gas lighting was to give the public a meritorious novelty in the way of using it, which, after a painful period of suspense and probation, was duly appreciated. There is no need to apologize for the reserve that gas engineers and others displayed towards the new Austrian comet when it "swam into their ken" with a good deal of more than usually diaphanous "tail." The invention was essentially one for an "outsider" to make. No gas engineer who had learnt all that was known about the use of gas for lighting purposes would have deemed it possible to make a satisfactory gas-light in any such way. A chemist brought it out; and no gas engineering credentials were for a long time forthcoming to vouch for its satisfying those practical requirements which everybody knew must be met if the thing was to come into anything like general use. What did gas engineers and lighting specialists know about the "rare earths," and the selective incandescent property that belongs to some of them? What did anybody (not excepting Dr. Auer) know of all this when he began experimenting with his "mantles"? So far as the gas industry was concerned, the incandescent gas-light was as much a discovery as an invention; and nothing that was advanced against Dr. Auer at the recent trial can upset or depreciate the plain facts that the creation of a working incandescent gas-burner was his, the type of it was settled once and for all by him, and everything else that has been done since in the same line is also after the pattern he set.

Perhaps we may be permitted here to make an exception for the shape in which the defeated rival of the Welsbach

light—the De Mare flat-flame burner with an incandescing fringe—was presented to the English public. On the face of it, this was something dissimilar to the now familiar "mantle;" and the English members of the De Mare Syndicate were careful to make it plain from the first that the issue between their appliance and the Welsbach property was to be tried out in the regular way. It was at least a fair challenge and an open fight. All the same, we never thought much of the De Mare arrangement, from the technical point of view. Into the consideration of the remaining litigation through which the Welsbach proprietary will yet have to wade, we cannot now enter. We are glad, however, to observe that the Incandescent Gas-Light Company are disposed to give the public practically as great a benefit, in the matter of cheapening the system, as could have been obtained by the destruction of their master-patent. This is really a subject of national concern, so deeply has the taste for this system of gas lighting penetrated through the community of gas consumers. If the Company continue to act upon this wise policy, it will hardly be worth anybody else's while to go into the business. Cheapness and excellence are, after all, the qualities upon which a manufacturing business must rely for lasting prosperity, after the adventitious aid of patent right has ceased to operate.

An invention of this magnitude is never produced in a perfect condition, for reasons that need not be pointed out. All that the most capable and foreseeing patentee can make sure of possessing himself, and consequently all he can give the world, is the germ of something new, that must be subsequently cultivated with devoted care, by himself or by others, if it is to develop into a workable appliance. It is this fact that exposed the Auer invention to the onslaught which has now been repelled by favour of good fortune as rare as the merits of the appliance itself. Not the least satisfactory of the results of the recent litigation is the proof given by it that the much-abused patent law of England will, with all its faults, afford a meritorious inventor of what can fairly be termed a "pioneer" invention greater protection for the subsequent working out of his necessarily imperfect ideas than he could probably obtain under the more rigid patent systems of other countries. We have said that the incandescent gas-light has not hitherto greatly helped the gas industry. This remark is meant to be taken with reference to purely technical considerations. Commercially, the system has already been of great value to the industry. The chief technical benefit that lighting by incandescence provoked by the heat of gas is able to confer, is still unrealized; but it must come in due course. We allude to the disestablishment of the convention of illuminating power, which has lain so heavily upon gas undertakings carried on under statutory restrictions in this and other countries. This will take time to bring about; but the end has now been practically assured. Whatever may be the future fortune of the Welsbach system, its universal reception by the world of gas consumers has given the industry of gas supply enormously greater liberty of economical development than it could have hoped for while the illuminating power of the naked flame was the measure of the value of the supply. If a new industry, in the collection and preparation of the "rare earths," has been created by the necessities of the Welsbach system, vast stores of hitherto almost valueless gas-making material will also be unlocked by the advantages which it brings from the conversion of heat into light; and so it may come to pass that the gas industry of the world will take a fresh departure, and assume a new shape, from this pregnant invention.

Photometers and Photometrists.

THE photometry papers of Mr. W. J. Dibdin and Mr. W. Sugg read at The Gas Institute meeting and reproduced in another column, constitute together a timely contribution to the elucidation of a subject which legal and other influences combine to keep prominently under the notice of British gas managers. Those who wish to know what such an authority as Mr. Dibdin has to say about photometers and photometry will be glad of the opportunity of reading his paper, and will be even more pleased to be able to read it by the additional light of his reply upon the discussion. Those who are pardonably bewildered over the complications both of design and compound nomenclature of the different varieties of "approved" photometers—to borrow a term from the statutes—will find Mr. Sugg a safe guide through these intricacies. What the plain man of business must want to know, however, is not stated either by Mr. Dibdin or Mr. Sugg, although it is nothing more recondite than the extent and nature of the influence, whatever this may be, which the box and the scale and the rest of the accessories exercise upon the operation of equalizing by the human eye the light given by the gas and the standard of light upon opposite sides of the screen. Perhaps when some experienced and trustworthy photometrist has retired from business, and occupies the enviable situation rejoiced in by the Miller of the Dee, one may get at the rights of this matter, if it has any. Truly, photometry is essentially a simple application of a familiar physical law. But the specialists have elaborated it out of all proportion to its exactitude as an act of observation; the law has elevated it to an undue eminence; and the instrument makers have been only too complaisant in trying to please every designer of what he fondly conceived to be a perfect apparatus. If we make bold to profess our disbelief in the necessity for all the elaborations that have been grafted upon the photometer, and echo Mr. Dibdin's plea for a return to primitive simplicity, we must also protest against his pronounced slur upon the sufficiency of the London testing-stations, and the arrangements under which they are worked day by day, as assuring consumers generally as to the integrity of their supply. Gas-testing stations, in London, as elsewhere, are instituted for the proper testing of gas; and if they do not secure this result, let it be for Mr. Dibdin or somebody else to propose measures for rendering them satisfactory. It is neither fair nor reasonable for Mr. Dibdin, or for anybody, especially if occupying a position such as his, to set up, against the returns obtained at these legal establishments, results alleged to be procurable elsewhere. We take leave to doubt if he would do this were the outside results more advantageous to the suppliers of gas than those certified under the law; and his remarks in this connection at the meeting of The Gas Institute are certainly not calculated to smooth the way for acceptance, on his recommendation, of any photometrical device which might be brought forward as an "improvement" upon existing practice.

The Question of the "Approved Burner" at Southport.

A LONG report of the proceedings which eventuated in the fining of the Corporation of Southport in three several sums of £10, with £75 costs, for deficient illuminating power in the gas supplied to the Birkdale district, will be found in another part of the present issue of the "JOURNAL." Voluminous as are the evidence and arguments in this case, the point upon which everything turned was a simple question of construction of the phraseology of the statute regulating the testing of the gas for illuminating power. In form, the case was heard by the Bench of Magistrates sitting at Birkdale Police Court on summonses charging the Southport Corporation with failure to supply gas according to contract. Various more or less interesting legal questions arose in connection with this procedure; but, in the event, these were cleared away, and the Court was left to deal with the main issue, which was as to whether the burners used respectively by the parties were in accordance with the true meaning of the Southport Improvement Act of 1871. This Act required the gas supply to be of 20-candle power, when tested according to the provisions of the Gas-Works Clauses Act, 1871, by means of a 15-hole argand burner with a 7-inch chimney, "or other approved burner." The Corporation, as manufacturers of the gas, contended that by these terms they were authorized to test it by means of the best kind of argand they could find for the purpose—in point of fact, they selected the Silber argand as being most suitable for the quality of gas to be dealt with. Their strong point was that the term "approved" must be taken as equivalent to "suitable;" and they were prepared with evidence to prove that competent expert opinion favoured the use of the Silber argand as a suitable burner for the purpose of burning gas of the quality supplied to Southport and Birkdale, and also that a 15-hole argand would not burn the gas at the regulation rate of 5 cubic feet per hour. On the other hand, the Birkdale case was that, in default of their agreeing to "approve" of any particular burner for the purpose, the gas must be tested by the prescribed 15-hole argand, which showed the illuminating power of the gas supplied by the

Corporation to be under the statutory figure. Hence the question was as to the meaning of the common term "approved" in this connection. It could not mean a burner "approved" by the Standards Department of the Board of Trade or any other outside authority, such as the London Gas Referees, for any purpose; because, as a matter of fact and of common knowledge, 20-candle gas is nowhere tested by means of a Silber burner. If the Corporation of Southport were to be entitled, under the terms of the Act, to "approve" of any burner they could find, and measure the illuminating power of their gas by it, why stick at an argand? Why not take a recuperative or an incandescent burner? Again, the fact of the Corporation having "approved" of a burner for their own purposes could not hinder the Birkdale District Council from "approving" of another—indeed, it encouraged such an exercise of photometrical fancy, if once the burner described in the Act were to be departed from. In the event, as already mentioned, the Court decided against the Corporation; and it is difficult to see how any other result could have been arrived at consistently with the wording of the Act as it would be read by plain men. Surely, if there are two parties to a commercial transaction involving the continuous sale and delivery of goods according to a stated pattern or any "approved" sample, neither party is at liberty to adopt another pattern or standard without the consent of the other. The principle is the same, whatever the nature of the goods dealt in. The gas industry, moreover, is deeply concerned in preserving the integrity of all statutory prescriptions relating to photometrical tests. It cannot be too strongly insisted upon that the photometry of gas is a convention, and must be carried out in a strictly conventional and duly legalized manner; no d parture in the smallest particular being permissible save by formal agreement between all the parties concerned.

An Impostor Punished.

The Southwark Bridge explosion case—in which, as will be remembered, the South Metropolitan Gas Company were condemned at the Lambeth County Court to pay £12 damages, and costs, to a man named James Price, who told a circumstantial tale of how he had been "blown into the air," to his serious personal injury—has had a somewhat sensational sequel. The Company never believed in the alleged injury, and appealed, without success, against the decision at the County Court. Circumstances afterwards came to their knowledge which induced them to have the matter followed up, with the result that, at the Central Criminal Court last Thursday, the interesting sufferer was indicted for having committed wilful and corrupt perjury on the occasion in question. It was proved that Price had some time previously lodged a complaint of a similar nature with the American Wringer Company, from whom he received 30s. as compensation for having been injured, as he alleged, by falling over a street grating belonging to the firm. These repeated experiences of his might have been mere coincidences; but the important fact for consideration was that about an hour after the Southwark Bridge explosion, he attended at the offices of the American Wringer Company to receive his compensation, when he was certainly not in the deplorable condition which gained the sympathy of the Lambeth County Court Judge. It is a source of legitimate satisfaction to all who are interested in the gas industry to know that this particular instance of fraud has been exposed, and the offender duly punished with the exemplary sentence of three years' penal servitude. Of course, the detection of the man Price does not affect the general statement of law applying to responsibility for the safe distribution of gas as it was left by the appeal in his case; but if the law is hard upon Gas Companies, as it undoubtedly is, this is all the more reason why malingerers should be deterred from taking improper advantage of it. So far as the personal aspect of the matter goes, it is somewhat depressing as indicating how easily a glib-tongued loafer can prevail upon a Court of First Instance to believe his story, when the defendants happen to be a public Company. Certainly, the moral of this side of the case is that exhaustive inquiry into the *bona fides* of casual complainants of injury from such affairs as that of Southwark Bridge should be insisted upon in every instance when they invoke the protection of the law.

WATER AND SANITARY AFFAIRS.

The decision of the Hybrid Committee on the Staines Reservoirs Bill, as given by Sir J. Pease on Tuesday, and afterwards somewhat modified, embraced a long catalogue of particulars, by which we fear the public were not much enlightened. The statement was primarily directed to the preamble, but it travelled considerably into clauses. The Chairman explained that the observations which he offered in the name of the Committee were expressive of the conditions on which the preamble would be passed; and the three Companies concerned were allowed time until last Friday to consider whether they would accept the amended Bill. On Friday, when the Committee met, Mr. Pope stated that the Counsel for the three Companies had very carefully considered the Chairman's statement, and had decided to ask the Committee to proceed with the Bill. Mr. Pope went on to deal with several of the points which had been raised, after which Mr. Middleton and Mr. Hunter were again called as witnesses, and gave evidence in support of the scheme. The Chairman then announced a further decision, still characterized by a considerable amount of complexity, though perhaps unavoidably so. While stipulating that the water flowing over the Bell Weir should not be less than 275 million gallons per day, the Committee went on to specify how much water might be pumped from the Thames, and how much should flow daily down the conduits from the reservoirs—the latter quantity to be enlarged by 10 million gallons per day with the consent of the Local Government Board, in case of necessity, which would bring it up to 45 million gallons daily. Debating whether the water, in proceeding from the reservoirs, should flow along open conduits or through pipes, the Committee ultimately decided in favour of the former plan, owing to the improved form in which it had been presented. How the new works were to be dealt with in the event of a transfer, was a matter for consideration; and on this point the Committee decided that if a transfer took place "within seven years" of the passing of the Bill, no additional value should accrue by reason of the supply of water secured under the Act. Of course, the works themselves, so far as executed, will have to be paid for when acquired. It is somewhat important that the Committee require the works to be completed within seven years instead of ten. If this should prove impracticable, Parliament must be appealed to again, which will be a further way of spending money. Or it may be that the Water Board will have bought all up in the meantime. A permanent source of expenditure is proposed in reference to the Thames Conservators, who are to get some extra value out of the water, in the shape of an enhanced contribution from the three Companies, though not necessarily on the same scale as the sum now paid. We shall see what the County Council have to say to this extra "tax on the consumer." The Committee finally decided that the limit for the quantity of water to be pumped out of the Thames should be 100 million gallons per day; and that, in the case of the Grand Junction Company, they would require a definite stipulation that a specified proportion of the water delivered on to their filter-beds should be stored water taken from the reservoirs proposed under the Bill.

On the whole, the Staines Bill has been treated by the Committee in a manner concerning which the three Companies are not likely to make any serious complaint, though there are some signs of a narrow escape. In the next place, we have to consider this Bill in its bearing on that of the New River Company; and Mr. Pope signified on Friday that, if the Staines Bill took a satisfactory shape, it might be found possible to abandon some portion of the other measure. If the Staines scheme is sanctioned, costing at least a million, the share which the New River Company have in the undertaking may render unnecessary some portion of the proposed outlay of more than a million and a half under their own Bill. But water must be had one way or the other; and the fact that six out of the eight Metropolitan Water Companies have Bills in Parliament this year for an extension of their works, is a matter on which London may be congratulated, as showing that the Companies are conscious of their responsibilities, and are anxious that there shall be no failure in the supply. Though it is a point of little consequence, it would have been well if

the Hybrid Committee could have allowed the preamble of the Staines Bill to recite that the scheme was connected with the project which Messrs. Hunter and Fraser laid before the Royal Commission, and which was referred to in the report of the Commissioners with a considerable measure of approval.

Respecting the Welsh scheme, at the last meeting of the County Council the Finance Committee sent in a report, stating it to be "quite impossible" at the present time, under all the circumstances, to give any opinion as to the effect on the rates in carrying out the scheme in question. It was in May last that the Committee were asked to undertake this probably uncongenial task; and now the reference is discharged "without comment." But is it so "impossible" to "form an opinion" on the subject? Taking the County Council's own estimate of cost, all other data are ready to hand. The prospect, however, is not at all encouraging, and the Finance Committee turn away from it. The projects brought forward by the London Water Companies will have no effect on the rates, except to increase the amount which the Companies will have to pay to the Local Authorities. To-day the County Council enter on the discussion of the water supply, adjourned from three weeks ago, including the purchase question as well as the Welsh scheme. The preparation of Bills is proposed in both cases. In the meantime, the Water Committee have called in the assistance of Sir B. Baker and Mr. G. F. Deacon, to advise on the engineering merits of the Welsh scheme as compared with any other mode of supply, including "the suggested scheme of "storage in the Thames valley."

PERSONAL.

Mr. W. Cross, the Engineer and Secretary of the Leamington Gas Company, has been ordered by his medical adviser three months of rest and change; and Mr. J. M. Somerville, of the South Metropolitan Gas Company, has been allowed to take the temporary superintendence of the works.

Alderman Hugh Bell has determined, owing to ill-health, to resign the position of Chairman of the Gas Committee of the Middlesbrough Corporation. The decision of the worthy Alderman has been received in the borough with considerable regret; he being an old and valued member of the Corporation. He has twice filled the office of Chief Magistrate.

Dr. J. C. Thresh, the Medical Officer of Health for Essex, has had the degree of Doctor of Medicine conferred upon him by the Council of Victoria University. The subject of the dissertation presented by Dr. Thresh was "Water and Water Supplies;" and the Council of the University have regarded it as of such merit that Dr. Thresh also receives the only gold medal awarded.

OBITUARY.

At the advanced age of 84, Sir J. Prestwich, the eminent geologist, died last Tuesday, at his residence at Shoreham, Kent, after a short illness. Until 1872, he was engaged in business as a wine merchant in the City; but from early years he was devoted to geology. Two of the works first published by him dealt with the geology of London—one on "The Ground Beneath Us," and the other on "The Water-Bearing Strata of the Country around London." The question of the distribution and utilization of underground waters was one that interested him greatly; and in connection therewith he did much good work, especially in relation to the water supply of towns. When the Royal Coal Commission was appointed in 1866, he was one of its members, and in this capacity he drew up two of the sub-reports—one "On the Quantity of Unwrought Coal in the Coal-Fields of Somerset," and the other "On the Probability of Finding Coal under the Newer Formations of the South of England." The favourable views he took in the latter case have been justified by subsequent investigations. He was a member of the Royal Commission on Metropolitan Water Supply in 1867. On retiring from business in 1872, he was appointed to the Chair of Geology at Oxford. Two years later, he received the Telford Medal from the Institution of Civil Engineers for his paper "On the Geological Conditions Affecting the Construction of a Tunnel between England and France." In 1888, he retired from Oxford, though in the same year he was President of the International Geological Congress which met in London. In his retirement, he continued his work to the last; contributing papers to various Societies. In 1849, the Geological Society awarded him the Wollaston Medal; and in 1865 he obtained the Royal Medal of the Royal Society. In 1885 he was elected a Corresponding Member of the Paris Academy of Sciences. This year Her Majesty conferred upon him the honour of knighthood.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE THIRTY-THIRD ANNUAL GENERAL MEETING,

HELD AT THE

SOCIETY OF ARTS, LONDON, June 9, 10, 11, 1896.

W. R. Chester, Esq., M.Inst.C.E., President.

We now complete our report of the proceedings at the above meeting by giving the three papers read on the last day, with the discussions thereon.

A STANDARD PHOTOMETER.

By W. J. Dibdin, F.I.C., F.C.S., &c.,

Chemist and Superintending Gas Examiner to the London County Council.

In response to the invitation of the Council of The Gas Institute to suggest, for the purposes of discussion, a form of photometer which should be suitable for general adoption as a standard instrument for testing the illuminative value of coal gas, I venture to offer the following considerations on the subject.

In a paper which I submitted to the Institute in June, 1888, the question of the efficacy of certain forms of photometers was discussed; and, as a result of what then took place, the Gas Referees had all the Evans photometers at that time in use at the official testing-stations altered to the form now known as the "Open Evans"—thereby causing that instrument to approximate somewhat to an open-bar photometer, but still leaving it in a condition liable to objection.

It may not be out of place to quote here the remarks of the late Mr. Heisch, in the course of the discussion on the paper above referred to:—

> He was free to confess that, until the Evans photometers were introduced in the City testing-stations, he was not absolutely ignorant of their existence, but pretty nearly so. He had been in the habit of going all about the country testing gas, but never met with one out of the Metropolitan district. They were almost all open bars; and he believed an open bar was the best thing they could possibly use. Free ventilation, both of the candle (or whatever the standard might be) and of the gas, was obtained. Two objections to the Evans photometer, besides its want of ventilation, were: (1) They looked at the disc through a pane of glass, which did not increase the facility of accurate reading; and (2) it was a temptation to a man to take a reading when his eyes were not in the best condition. He would sit in a light room, and just go under the hood, and take his observation. But if he waited (say) one or two minutes after getting under the hood, the observation would probably be different. With regard to the Evans photometer, there seemed to him to be an idea that it invariably increased the apparent light of the gas, and diminished that of the standard. But he happened to have in use two photometers which had precisely the reverse effect, most distinctly depreciating the quality of the gas to a considerable extent. In order to be at all fair to the companies, he took off the bottom trough in which the cords ran, and sometimes the top cover: and he now obtained from the two photometers very much the same results as he did with an open bar—which was almost invariably from 1 to 1½ candles higher than he could get before he took off the bottom. He thought this peculiar effect might be due to that circumstance; but, not being quite certain about it, he only threw it out as a suggestion. The disc-holder in the centre of the photometer happened to fit very close indeed; so that both the heat and the carbonic acid generated principally at the gas end did not find their way beyond it. Therefore, the candles were, comparatively speaking, little affected—there being only a slight rise of temperature, whereas all the carbonic acid was collected on the gas side, and he believed it was this which had the depreciating effect. He mentioned this to show that the Evans photometer did not always work in favour of the gas company.

In considering the most suitable form of photometer, it would appear as if the main point desired was entirely lost sight of, and secondary considerations allowed to have full sway. I propose, therefore, to glance briefly at the primary conditions, and then to adhere to these in any future consideration of the subject.

In the first place, a photometer is but a light-measurer, and, strictly, has no relation whatever either to the light to be measured or to that of the standard with which it is compared. It has happened that, as a matter of convenience, the surroundings of the burner, &c., have gradually developed until they would seem to be of more importance than the instrument itself. True, if it is desired to affect the quantity of light afforded by either the gas-flame or the standard, or both, and so to tamper with the thing to be measured or its measure, then by all means surround

them with artificial aids designed to that end. This matter must be thoroughly threshed out before any discussion can take place with advantage as to what should constitute a "standard photometer."

What do we want to measure? Is it the value of 5 cubic feet of gas consumed per hour in a definite burner, under normal conditions in a quiet atmosphere; or do we desire to vary these conditions, and artificially enhance the effect of the burner in producing a certain volume of light? Again, do we desire to measure this light against candles, or any other illuminant which may be employed as a standard, burning, as candles should, in a quiet, properly ventilated atmosphere; or do we desire to shut them up in a hot cupboard, filled with vitiated atmosphere, thus causing them to yield a more or less smoky flame, and so artificially raise the value of the gas-flame opposed to them, by debasing that of the standard? On the other hand, is it desired to obtain the result described by Mr. Heisch, and lower the value of the gas-flame, while leaving the candles unaffected?

If this point is settled in favour of the production of an instrument which shall be capable at will of yielding the highest possible readings either for or against the gas, irrespective of first conditions, then by all means let the closed Evans be adopted. Let it be fitted with shutters, apertures with flaps, and ventilating tubes here and there, to be opened and closed at the will of the operator, according as he requires high or low results. By this or that contrivance, he may supply fresh warm air to the gas-burner, and leave the candles or other standard bathed in their own products of combustion. Or, by reversing the process, we may debase the gas, and allow the standard to rejoice briskly in all the luxury of fresh oxygen. Grotesque as this picture may appear, it unfortunately is only too true; and all photometers must *of necessity* be more or less of this character, whenever they assume the form of a closed instrument.

I presume, however, that what all reasonable men desire is an instrument which will yield results of constant character, as far as the steadiness of the lights under comparison will admit, and which shall indicate the fair and true value of the gas, when burning freely in a properly ventilated room, in terms of a standard candle burning under like conditions. If this point is conceded—and I cannot imagine any other being seriously proposed—the problem solves itself. Burn the gas in an open atmosphere in a freely ventilated room. Let the candles (or standard, whatever it may be) be burnt under the same conditions. Place the disc at the point between the two illuminants where equality is found, and measure from one to the other, preferably by reading a scale (otherwise called the "bar"), which in its essence is only a two-foot rule. Screen the eyes of the observer from direct rays from either light; and we have a perfect instrument, so far as the photometer is concerned.

Doubtless I shall be at once told that I am advocating King's photometer, with Bunsen's disc. Exactly; that was the first form of our most generally used photometer; and I maintain that it is the best. The moment complications were introduced, the troubles commenced; and they will continue until all the present "top-hamper" is cleared out, and the much-abused gas and candles are again allowed a "fair field and no favour."

I have been much amused at an account of certain experiments made with, or rather supposed to be made with, the pentane argand standard of light. I say "supposed to be made with," because from the account given I find that the instruments employed were used, or rather misused, in almost every way except that in which they were intended to be used. It seems that two of these standards were placed in an Evans photometer, and were found to disagree. They were then removed, and placed on an open-bar photometer; and they were then found to agree. On being again placed in the Evans, they disagreed. The remarkable fact about this experiment is that the writer did not see that he was condemning the Evans photometer! How would these standards have behaved in the photometers, so called, described by Mr. Heisch?

I would suggest the following experiments to those who advocate the use of closed instruments. Let them place a standard argand burner in each end of an Evans photometer, and consume exactly the same volume of gas from the same main in each burner, and then observe the result. Do the same thing on an open bar. When I say an "open bar," I do not mean a Canadian—that is a "shut up" bar—but in an absolutely open bar in the middle of a well-ventilated room. Then compare the results. To make the experiments with the Evans more marked, readings should be made first with the flaps, &c., open on the right-hand side and shut on the left hand; and then the process should be reversed.

If we now decide upon the adoption of a simple bar, as first suggested by King, it will be well to definitely state the extent of the departures from his primitive form which modern experience shows to be advisable. These, of necessity, must be limited, or the original simplicity and accuracy will vanish. First, the disc should be mounted in an easily moveable box, in the manner recommended by myself some years ago, and now generally adopted—viz., so that both the disc and mirrors can be rotated after the first half of the set of readings has been made. Second, a velvet curtain should be hung at the back of, and 12 inches from, each light, to prevent reflection from walls, &c., on to the disc; and another in such a position as to shield the eyes of the observer from direct rays. Third, the table on which the photometer and burners stand should be as near the middle of the room as possible, so as to avoid those currents of cooled air which, especially in cold weather, fall down against the walls. Fourth, the room should be properly ventilated, without draught, and should be kept at a temperature as near 65° Fahr. as possible. Fifth, the room need not of necessity be painted black; a subdued dead-wash being amply sufficient for all purposes.

A modification in the manner of recording the readings has been suggested to me by Mr. A. F. Damon, one of the London Gas Examiners, which seems to promise very well. This is to place a paper scale on the photometer bar, under the disc-box; and instead of the observer reading off each observation as at present, he should impress on the paper, by means of a spring-pointer, the position at which the disc stands at the moment of observation. As each impress of a series of ten readings could be made to fall on the paper scale at positions a little lower than the previous one, the order in which they were made would be seen at once. The advantage of this alteration would be that of necessity the observer would be unbiased in his readings by not being able to see the scale at the time; and, further, the impressed scale would be preserved for future reference.

The suggestion has been made that the gas should be burnt in quantity sufficient to fill the burner with flame, and the value ascertained by measuring the quantity of the gas consumed and calculating the intensity yielded by a constant volume, by reducing the readings in ratio to the consumption. This question, however, affects the character of the burner to be employed, and not that of the photometer; as in any case that instrument should remain identical in character, whatever the burner employed, or the method of its use.

The proposal to use the modified Foucault photometer, suggested by Mr. Vernon Harcourt, is decidedly good, in that it necessitates the two illuminants being burnt in the open, and entirely unaffected by screens or draught regulators, which, as already shown, soon become converted (intentionally or not) into apparatus for altering the conditions affecting the combustion of the gas or standard, or both. This instrument is tantamount to bending the photometer bar at its centre, bringing the two ends nearly together, and placing the disc at the apex of the triangle so formed, so that it faces the observer. The use of slits in a brass diaphragm enables respective portions of the greased paper to be illuminated by the opposed lights, when the intensity can be equalized either by moving one of the illuminants or altering its value by varying the volume of the gas consumed in the standard burner.

The alterations required to existing photometers, to bring them into accord with this method, virtually amount to a new instrument; but as any ordinary bar photometer can readily be arranged to make it comply with the conditions I have suggested, the desirability of such a complete substitution does not seem to be very urgent—especially as the "table" photometer would bring into use a method of reading to which few are accustomed. These objections, however, are trivial, if it be really deemed desirable to make such a complete change in existing arrangements. The great point is that the two lights should be burnt

without artificial aids of any kind; and this is assured with either King's "bar" or the "table" photometer.

PHOTOMETERS AND STANDARDS OF LIGHT.

By William Sugg, of London.

It will be readily conceded that the photometer, with its accessories, forms one of the most important pieces of apparatus on a modern gas-works, because it is the means by which the engineer verifies the illuminating power of the gas which he supplies to the public, and satisfies the municipal authorities that the terms of the company's contract under this head are fulfilled. Thus the photometer is, or should be, a standard measure, consisting of three important parts—viz., the standard burner and chimney, suitable to consume 5 cubic feet per hour; the standard spermaceti candles, serving in this country and its colonies as the standard of light with which the gas is to be compared; and, finally, the photometer bar and its disc or screen, by means of which the gas examiner fixes the exact distance between the two lights where the light is found to be equal on both sides of the disc. At this point, he finds the number of parliamentary candles required to equal the gas in light-giving power.

There are meters fixed in every consumer's premises, which register the quantity consumed with commercial accuracy; but the monetary value to the public of the gas thus supplied depends largely on the amount of light to be obtained from a given quantity of it. Parliament, in granting statutory powers to gas companies and corporations, has for many years past recognized this fact; and in almost all the Acts which confer these powers, it is stipulated that certain photometers and burners shall be used, in conjunction with proper candles carefully burnt in a certain manner, in the verification of the statutory illuminating power of the gas supplied—penalties being incurred in case of failure to comply with the terms of the contract. It is, therefore, evidently of great importance that the details of the photometer and its accessories should be rigidly adhered to by both parties to the contract.

The object of this paper is to ventilate this question, in view of the fact that there appears to be a disposition on the part of some municipal authorities to adopt certain modifications in the photometer itself, and in the method of using it, which would have the effect of raising the parliamentary standard and increasing the initial cost of maintaining that standard, without in any way compensating the suppliers of gas for the extra illuminating power thus required. In one case now before Parliament, a powerful Corporation, with a Lord Mayor at its head, have not scrupled to stigmatize the photometer originally adopted in the Act regulating the illuminating power of the gas to be supplied to their city, as an "obsolete" instrument; and have brought a Bill into Parliament to authorize another photometer to be used, differing materially from that prescribed in their Act, and, more than that, to considerably alter the conditions of supply, making them more onerous and difficult for the Gas Company. It is noteworthy that the photometer in question was re-imposed only a year or two back as a result of arbitration. If this Corporation can succeed in their object, they will doubtless have imitators; and finally the whole system of the supply of gas under Acts of Parliament by gas companies, and even corporations, may be thrown into confusion

In order to facilitate the judgment of this Institute, the author feels it necessary to go a little into ancient history, which he hopes, however, will not be uninteresting. The standard burner to be used is defined in a large number of the gas companies' Acts as an argand, mostly followed by the words "or other approved burner." Sometimes it is only referred to as a 15-hole argand, with a 7-inch chimney. About one-half of the gas companies in the United Kingdom are in this category. In a few cases, no standard burner or standard of illuminating power or photometer is mentioned; such important cities as Manchester, Worcester, and Warwick being in this latter category. There are a few companies—such as Liverpool—who use the Gas Referees' flat-flame burner (Sugg's No. 7) as a standard for testing 20 or 21 candle gas. In the Dublin Act alone a "suitable" flat-flame burner is prescribed for testing 16-candle gas. Now, there is no standard flat-flame for 16-candle gas.

It will be necessary here to state that most of the companies and corporations whose Acts vaguely describe the standard burner, have adopted the "London" argand No. 1, as prescribed by the London Gas Referees, as an "approved burner." Some have this burner made with 15 elongated holes, because the Act specifies that the number shall be 15, but omits to mention the size or shape of these holes. This curious circumstance, it is believed, was evolved out of the controversy originated by the late Mr. Samuel Hughes, who took the view that, in the interest of the public, he had a right to have the gas tested by the worst burner he could find. The worst argand burner to consume the statutory quantity of 14 or 16 candle gas is that with an iron top and 15 holes, each of about 1-100th of an inch in diameter.

The next worst is a *chef d'œuvre* for which Mr. Samuel Hughes was primarily responsible—viz., the old Birmingham 15-hole, with a bell-metal top, used with a 7-inch chimney, for testing 14-candle gas. It is needless to say that Birmingham has got rid of it, and now uses the "London" argand. This unfair view taken by Mr. Hughes was to a very great extent disposed of by the House of Commons Committees sitting under the chairmanship of Mr. Sotheron-Estcourt and Mr. Cardwell, in 1867-68. They both found that the view adopted by Mr. Hughes was wrong. In the result, they directed, in the City of London Gas Act, that the Gas Referees were to fix upon a burner which would at the same time be the best for the consumer as well as the best burner for developing the illuminating quality of the gas, to be used as a standard burner for testing the gas.

But notwithstanding this judgment of the Parliamentary Committees, there remained an indisposition on the part of those who promoted Gas Bills, as well as on the part of those who opposed them, to properly define the standard burner. In consequence of this, there has always been more or less divergence in the actual and nominal illuminating power of 12, 14, and 16 candle gas in various parts of the country. When it is considered that from time to time statistics have been, and are still, published, and evidence given before Parliament, in which comparisons are made of the prices at which gas is supplied to the public in different cities and towns, it is evident that these divergencies in the standard burners must have led to a considerable amount of misapprehension, and even injustice in certain cases. Everyone will agree that 12, 14, 16, 18, or 20 candle gas ought to mean the same quality in every part of the British dominions. Yet it is undeniable that this is not the case. It is a very significant fact that the only standard burner, which has been acknowledged as such by the Standards Department of the Board of Trade, is the Gas Referees' 14 and 16 candle burner—one burner being used, with different sized chimneys, for both qualities of gas.

The only other standard burner which has been accurately defined by Parliament is the Sugg "Preston" argand burner for 18-candle gas. There is no 12 or 20 candle argand standard burner prescribed or approved by Parliament; nor is there any 25 or 30 candle burner for Scotch gas. The Gas Referees' flat-flame standard is of a vacillating character; and, like most other flat-flame burners, it is not at all suitable to develop the true illuminating power of the gas, especially when it happens to fall a little below the standard, or when it is well above it.

The author begs to submit a photographic view of the behaviour of a flat-flame burner in a photometer, consuming the statutory 5 feet per hour of 18 candle gas, in a room free from draught, excepting that produced by the natural movement of the air therein, promoted by the burning of the gas itself and the necessary movement of the gas examiner in making his observations. This will strongly support the opinion of the author that a flat-flame burner (or, as the French call it, a *flamme libre*) is not a proper standard burner to test gas with. The exposure was two minutes; and the burner and flame are shown natural size.

It will be well here to state a fact in the ancient history of burners used for testing gas, which is vouched for by the author, and will throw some light on the statements occasionally made as to the quality of the gas supplied in the years before 1863. In the year 1847, the author was taught by the late Mr. Thomas Livesey the method of testing the illuminating power of the gas supplied by the South Metropolitan Gas Company, which was then

considered to be 13 candles per 5 cubic feet. The burner was an argand, with a 7-inch chimney; and it had 15 holes in it. These holes, when the burner was new, might be about 1-100th of an inch in diameter; and they were carefully kept uniform in size by means of a small taper brooch, very little larger than 1-100th of an inch in its thickest part.

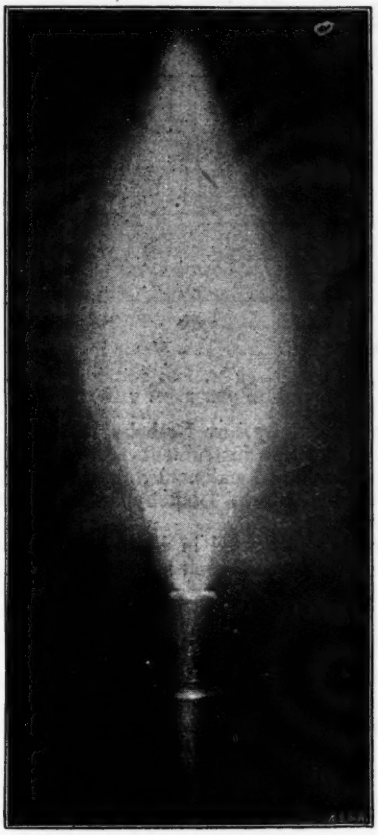


FIG. 1.—VIEW OF FLAT-FLAME BURNING IN PHOTOMETER, LOOKING ON TO THE EDGE OF THE FLAME.

Some years after this, the author found in use at the Chartered Gas Company's works, for testing their gas, an argand 15-hole burner, which was larger, however, in diameter than that used at the Old Kent Road works. Subsequently at Fulham Gas-Works, Mr. Thomas Kirkham showed the author another 15-hole argand burner, with a platinum top, with holes a little larger than the South Metropolitan burner. It was afterwards discovered that the South Metropolitan burner was a relic of the time when the late Mr. Palmer was Engineer of the Company, which, under his direction, manufactured cannel gas. The Western Gas Company at Kensal Green, also under the direction of Mr. Palmer, used an argand burner with 15 holes, similar to that employed by the South Metropolitan Gas Company. It is most likely that, when Mr. Alexander Wright was Engineer to that Company, they used a flat-flame burner of some sort, because he appears to have been in favour of them; but no burner was specified.

The other London Gas Companies—viz., the Imperial, Chartered, South Metropolitan, Phœnix, Commercial, Ratcliff, London, Great Central, and Independent—used argand 15-hole burners, fitted with 7-inch chimneys, as did also the different Gas Examiners—Dr. Warrington, Dr. Letheby, Dr. Leeson, Dr. Graham, Dr. Brand, Mr. Lewis Thompson, and others. It is very remarkable that the 7-inch chimney, by 2 inches external diameter, seems to have been employed with all the 15-hole burners for gas of 12, 14, 16, and even 18 candles. It could not possibly suit them all, nor could it suit the different diameters of the 15-hole burners; but it was used nevertheless. No two burners were exactly alike. They differed in many important points; but it was generally supposed, up till 1858, that no matter what 15-hole burner was used, the result in illuminating power with a consumption of 5 cubic feet was about the same.

In 1857, the author of this paper obtained leave to try some eight or ten argand burners used by the London Gas Companies and the Gas Examiners; and the result of testing them all with the same gas and photometer was a difference of about 5 or 6 candles between them. The quality of the gas supplied by the different Companies was supposed to be from 12 to about 16 or 18 candles; the Western Cannel Gas Company being the highest in quality. The rest of the Companies supplied what we should now call from 13 to 14 candle gas, as far as the author was able to judge. It is not astonishing, therefore, that a difference of 25 per cent. between the experts on the one side and on the other was a common thing.

It was not till 1858 that the late Mr. George Lowe, F.R.S., and Mr. F. J. Evans took up the question of the adoption of a standard burner—moved thereto by the results of the author's experiments, which they verified. In parentheses, the author remarks that it was very curious that Mr. George Lowe, in Finsbury Circus (where he had his laboratory), used an argand burner invented by a Mr. Leslie, a tailor in Regent Street, in the West-end of London. This ingenious burner had a number of tubes from which the gas issued, instead of holes. Mr. George Lowe first explained, personally to the author, the effect of long and short chimneys upon the illuminating power of gas consumed in an argand burner; illustrating the damaging effect of a long chimney upon a Leslie burner. The Leslie burner he used generally with a 3-inch chimney. Excepting for the regularity of the flame and the diminution of the shadow, it was not generally known that this burner was any better than any other consuming a like quantity of gas.

However this may be, it was Mr. George Lowe who presented to the notice of a Committee of the House of Commons the first attempt at a standard burner made by the author. This was a 15-hole argand, with a top drilled with holes nearly $\frac{4}{100}$ths of an inch in diameter, instead of the iron one with small holes, and with the inevitable 7 in. by 2 in. chimney. It was promptly rejected by the Committee, at the instance of Mr. Samuel Hughes. The author mentions these facts because it is very important, in view of various statements made from time to time in Parliamentary Committees by expert witnesses, to show how very little the real illuminating value of the gas supplied by different companies could have been known at that time.

By the continuous interest taken in the question of illuminating power by Mr. George Lowe, Mr. William King, of Liverpool, Mr. F. J. Evans, Mr. T. N. Kirkham, and, on the part of municipal officers, by Dr. Warrington and Dr. Letheby (to all of whom the author was deeply indebted for instruction and help in this work), the system of photometry now in use all over the kingdom, and the settlement of the standard burner and other apparatus necessary to more accurate working, first obtained a start. The adoption of the Sugg-Letheby 15-hole argand burner was the first step towards uniformity in properly burning the statutory quantity of the gas to be tested. Adopted by Dr. Letheby in 1863, this burner became largely used throughout Great Britain and her colonies for testing gas, as well as for the purposes of lighting. It never, however, became a standard burner, most probably because of the continued opposition of those who adopted the Hughes theory; but it undoubtedly led to a generally greater accuracy in testing gas, and therefore to a more accurate knowledge of its cost.

Proceeding now to the photometer on or in which the standard burner is used, it is remarkable that the Gas-Works Clauses Act of 1871 adopts the two photometers which were prescribed for use, under their authority, by the Gas Referees for London in 1870, after serious investigation. These were the well-known Letheby and the Evans photometers. Previously to the adoption of these instruments for gas-testing purposes by the Gas Referees, a variety of other photometers were in use, which gradually were superseded by those above mentioned.

Amongst these latter, it is interesting to mention the photometer of Count Rumford, which is shown in "Clegg's Treatise on Coal Gas." This instrument was an enclosed photometer; and the gas was probably burnt in an argand burner either of the Clegg or the Bynner type. The burner was placed at such greater distance from the point of comparison than the candle that the light from the candle would, at the shorter distance from the point of comparison, equal the light of the gas at a longer distance. The light given by the gas was probably about 12 candles; and the

distance of the candle from the point of comparison, squared, would go twelve times into that between the gas and the point of comparison likewise squared.

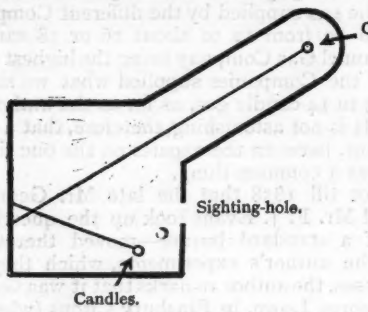


FIG. 2.—RUMFORD PHOTOMETER.

This point of comparison was a piece of white paper, on which the shadows of a small stick were separately projected by the respective lights to be compared. The observer looked through a sight-hole in the front of the box. If the shadow produced by the gas was not equal to that produced by the candle, the gas was turned up; but if, on the contrary, it was more than equal, the gas was turned down. The quantity of gas was doubtless measured by Count Rumford himself, although it is very probable it was only roughly measured by the height of the flame, in practice, for gas testing.

This instrument was modified by Foucault, the French scientist, and adopted by Dumas and Regnault in drawing up the *Traité* made between the Paris Gas Company and the Municipality, in 1858, which is still in force. The Paris instrument is closed in front, and open at the back. As regards the position of the lights, the author ventures to think that the idea of Count Rumford is the better of the two, because the direct rays of the gas are more shaded from those of the candle. Instead of the hole through which, in Count Rumford's photometer, the comparison between the shadows was made by the observer, Dumas and Regnault adopted what they called a *lentille*—or eye-piece—through which the examiner compares the degree of illumination produced by the gas-light and the standard of light, upon a screen made by grinding fine rice mixed with gum between two pieces of glass. It is to be noted that the examiner can only use one eye at a time. This is not an improvement on the Rumford photometer.

The author mentions these instruments because one of the latest photometers, designed by Professor Vernon Harcourt, F.R.S., and proposed to be used for testing the gas supplied to London, is very much on the same lines as these older instruments. The Professor does not, however, use the *lentille* adopted by the French; and it is believed that he desires to enclose the instrument by black velvet curtains, to cut off reflected rays from the walls of the room in which it is used, which is not done by the French. In all these, the equality between the lights must be obtained by turning the gas down or up.

The author is of opinion that this method, which answers well in France, is unsuitable to the comparatively very rigorous methods of testing adopted in England. A not very decided man may turn up the gas and turn it down again many times during an experiment, before he satisfies himself that the two lights equally illuminate the screen—more especially if the colours differ. Thus the quantity of gas used to equal the standard light may be inaccurately registered, and the result be rendered doubtful. The standard for France is the carcel lamp, which is equal to 9·5 English candles.

Now, under the Gas-Works Clauses Act, the average of two tests taken at any time between the proper hours would, if they were below the standard to any extent, subject the supplier of such gas, if a company, to penalties. In France generally some hundreds of tests, extending over a considerable period of time, are required to penalize a company. The Paris Gas Company is allowed a three months' average of the results obtained every night in the 23 arrondissements of Paris. Therefore the Paris photometer and the French standard of light (the carcel lamp), need not be practically considered in relation to the testing of gas in England.

It is here necessary to say, in speaking of Professor Harcourt's photometer, that he proposes to use his pentane argand as a standard of comparison, instead of either the candle or the carcel lamp. This, together with his tracing-paper screen, which is seen by both eyes at once, constitutes a most important difference between his proposed photometer and the Foucault and Rumford instruments.

Previous to 1858, there were three types of photometers in use in Great Britain—namely, King's 100-inch photometer, the Church and Mann photometer (fig. 3) and a kind of flat-rule 60-inch bar, fitted with a bunsen disc without any

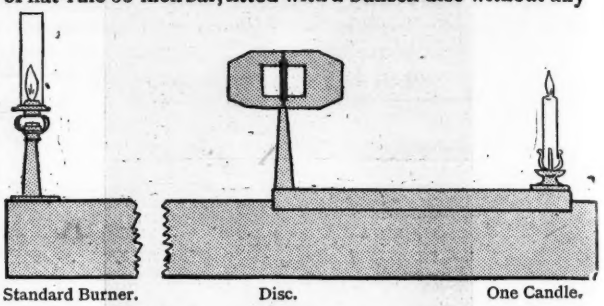


FIG. 3.—CHURCH AND MANN PHOTOMETER.
CANDLES AND DISC BOTH MOVING TOGETHER AT A CONSTANT DISTANCE ONE FROM THE OTHER.

screens, employed by Dr. Letheby in his laboratory at Finsbury. All these instruments were used in darkened rooms with blackened walls. From these two latter was evolved the well-known Letheby 60-inch photometer, in or about 1863.

Mr. George Lowe used in his laboratory at Finsbury Circus, in 1858, a small enclosed photometer, about 4 feet long. In it he used a Leslie argand burner, with a 3-inch chimney, consuming 5 cubic feet of gas per hour; and as a standard of light he employed a jet of the same gas as that used in the argand burner, regulated to a height of 2½ inches. He carefully adjusted this jet by means of a pair of steel compasses; and the light given equalled a candle. From a considerable knowledge of this instrument and standard, the author can testify that the results obtained by Mr. Lowe were remarkably accurate; but it must be considered that he controlled the correctness of his experiments by means of the jet photometer, which he had invented and given to the author. Mr. Lowe used his little photometer in an ordinary room, slightly darkened by means of black calico blinds. In like manner as the Letheby photometer was evolved from King's, it is quite possible that the first idea of the Evans photometer was obtained from that used by Lowe.

It may comfort many engineers who have occasional trouble with candles, to learn that Mr. George Lowe rarely used them. There was a noble pile of spoilt and rejected candles alongside his photometer; but from the time he had found his 2½-inch jet and his jet photometer, he never trusted any more in candles. The author cannot say that there appears to be much more confidence in the minds of the engineers of to-day as regards candles.

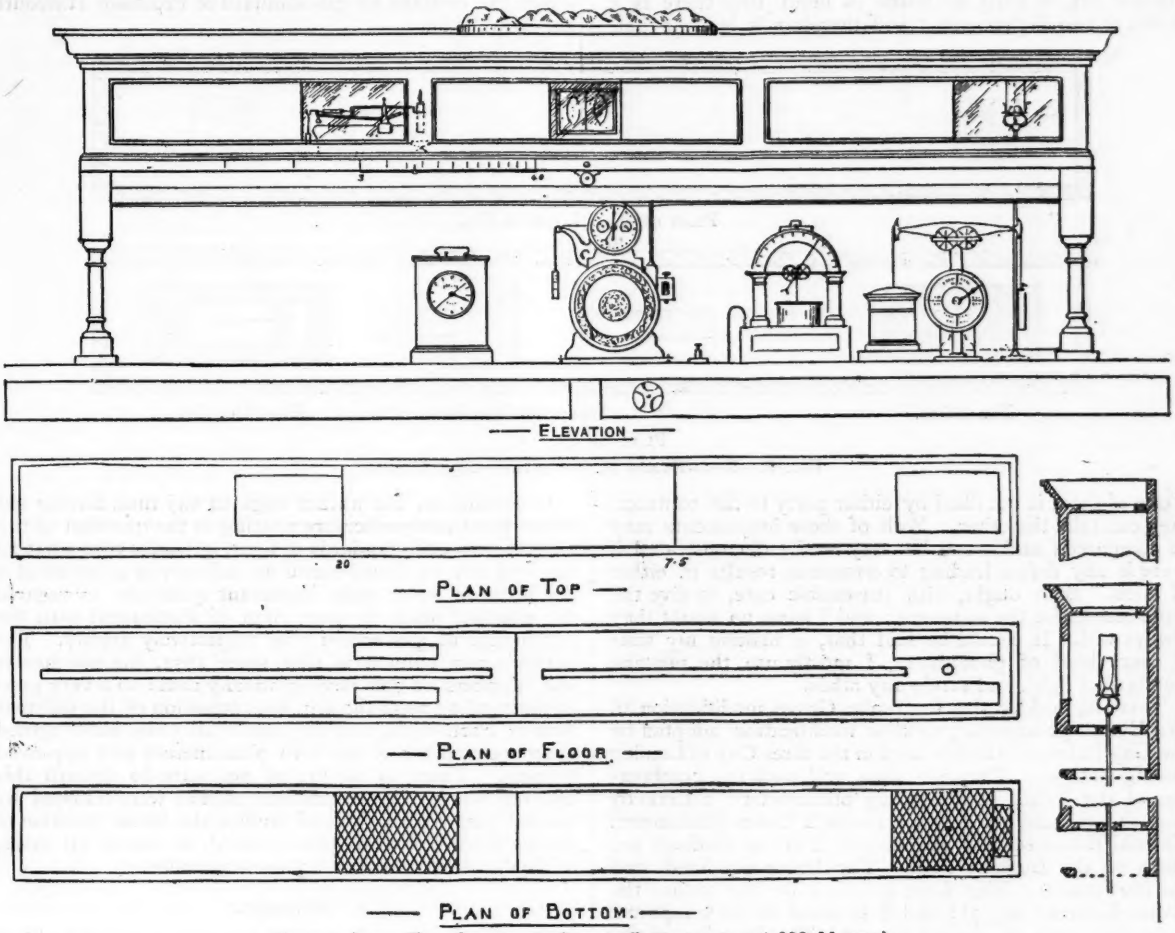
Of the two photometers prescribed in the Gas-Works Clauses Act, one of them—viz., the Evans—has been modified by the present Gas Referees for London; and this modification (shown in figs. 4 and 5) is in use in ten out of the twenty-three London testing-stations. The first Evans photometer to be modified was that at Ladbroke Grove; and it is consequently known as the "Ladbroke Grove" pattern of the Evans photometer. This modification was made in 1888, in consequence of some experiments undertaken by the Gas Referees and Mr. Dibdin, the Chemist to the London County Council. The results obtained are said to have been phenomenal; 16-candle gas having been found to be in some experiments as high as 19 candles and more.

The author, although he was the maker of this photometer, was not asked to be present at any of these tests; and he desires to remark that, in his opinion, the wild results obtained must have been due to the state of the weather combined with inefficient ventilation of the room, because photometers of precisely the same form and dimensions as the original Evans give constantly, in a large well-ventilated room, exactly the same results, with the "London" argand burner, as does the Letheby photometer—the alternative one prescribed in the Gas-Works Clauses Act. There is one thing which probably might have conduced in no small degree to produce the above-mentioned erroneous results, and that is the doors of the

photometer might have been kept closed for a much longer time than was required to perform a proper experiment—viz., 10 minutes, or rather 9 minutes. The Gas Examiner at this station had for some years been making his tests with the same instrument, without finding such extraordinary results.

The author has carefully tested many of the original Evans photometers alongside the Letheby and Canadian photometers in a well-ventilated room, and found them to give like results, when the doors of the Evans photometer are opened after each completed test. As keeping the doors closed for a long time goes in favour of the gas, no gas examiner desirous of fairly doing his duty would work in this way.

It is probably the report of these experiments, and the knowledge that the Gas Referees ordered the Evans photometers under their jurisdiction to be altered, which led to this photometer being called "obsolete" by persons



FIGS. 4 & 5.—THE LADBROKE GROVE PHOTOMETER (1888 MODEL).

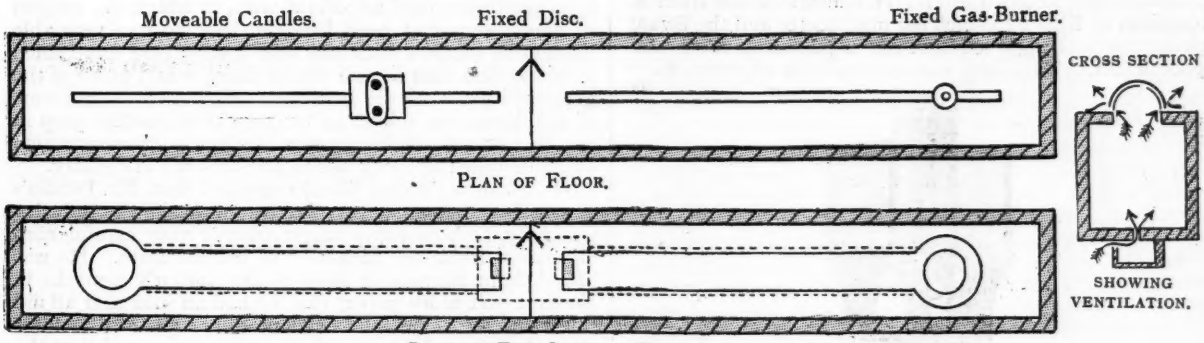


FIG. 6.—EVANS PHOTOMETER—1858 MODEL.

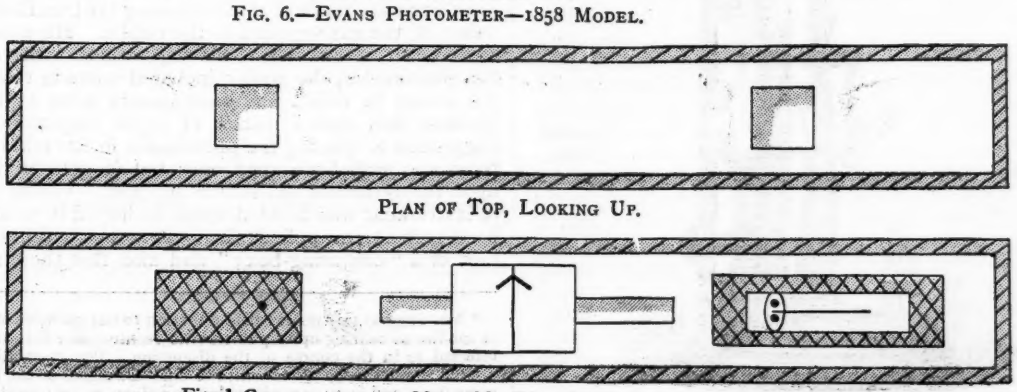


FIG. 7.—EVANS-LETHEBY MODEL AT CITY TESTING-STATIONS

who do not bear in mind that the contract to supply gas of a certain quality implies likewise the continued use of the photometer as it was at the time when the contract was made. It is now more than 35 years since the original Evans photometer (fig. 6) was invented; and it might, with our present knowledge, be improved. But, on the other hand, so might the standard burner; and so might also the British yard measure, in the same sense.

As regards the photometers prescribed in the Gas-Works Clauses Act, it must be borne in mind that there is a choice of two instruments; and therefore it is clear that, if one of them is not liked by either party to the contract, they can take the other. Both of these instruments may be compared; and it can be very easily demonstrated if there is any defect leading to erroneous results in either of them. Both ought, with reasonable care, to give the same results for the same gas; and I have no doubt they always will. It should be said that, in making my tests of every kind of photometer, I mostly use the pentane standard of light, and rarely any other.

There is, besides the Ladbroke Grove modification of the Evans photometer, another modification adopted by the Gas Referees which is used in the three City of London testing-stations. They are alike, and each is a combination of the Evans and Letheby photometer; a Letheby 60-inch bar being put inside a 100-inch Evans photometer. The old Evans scale is abandoned; and the readings are taken on the Letheby scale. The lights are fixed, and the disc moves. This form is called by the author the Evans-Letheby (fig. 7); and it is found to work well and accurately with an argand burner. The Warden of the Standards has stamped several photometers which are combinations of King's 100-inch bar photometer and the Evans photometer. King's 100-inch bar is put inside the Evans photometer. This form was first made in 1892 (fig. 8).

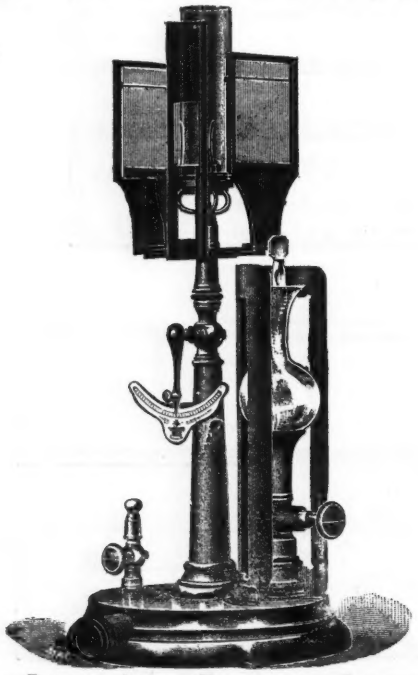
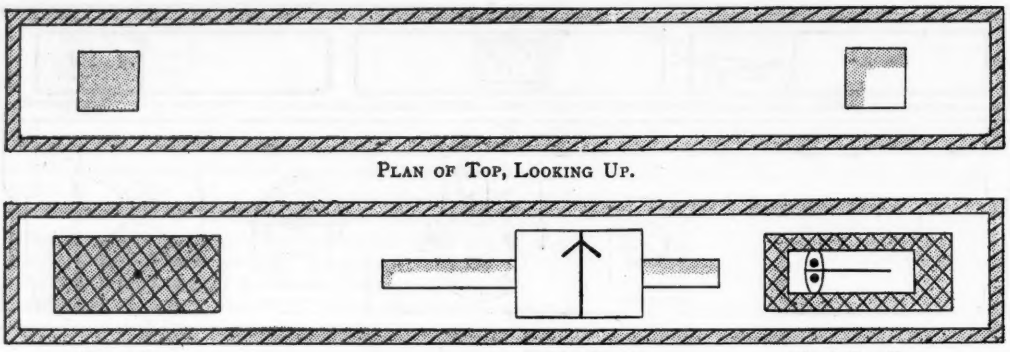


Fig. 9.—Pentane Argand Burner with Carburettor.

Of the other photometers used in London, there are two of the Imperial standard pattern on The Gaslight and Coke Company at Hornsey and Westminster; two of the Canadian Government pattern on the South Metropolitan; and six of the Tooley Street pattern on both The Gaslight and Coke Company and the South Metropolitan Gas Company. All of these, judging by the daily returns, seem to give equally accurate results. It is to be noted that the "London" argand is used in all these stations. Fig. 9 shows the pentane air-gas standard of Professor Harcourt and Mr. Dibdin.*



Plan of Top, Looking Up.

Plan of Floor.

Fig. 8.—King-Evans Photometer—1892 Model.

In conclusion, the author begs to say that, having put before you these particulars relating to the question of the photometers and standards of light, he thinks that what he has said will be found useful in aiding you to arrive at a just decision upon these important questions, as regards the contract made in your Acts of Parliament with the purchasers of gas whom you respectively supply. The author's own opinion is that, since 1871, the purchasers and suppliers of gas have gradually come to a very good understanding as to the fair interpretation of the different Acts of Parliament, and in almost all cases have agreed upon one or other of the two photometers and approved burners. There is no urgent necessity to disturb this understanding. If the pentane argand were adopted by mutual consent, in place of candles, the whole question of testing the illuminating power would, in almost all cases, settle down into satisfactory working order.

Discussion.

The President said that the two papers which had just been read were very important ones, in which the subject of photometry had been brought forward in a very able manner by authors who had had a very long experience in connection with it, and whose views would prove of the greatest interest to the Institute. He hoped the outcome of the discussion might be to carry them another step in the direction of obtaining a standardized instrument which could be relied upon for use in all parts of the country.

Mr. F. Beale (Nine Elms) remarked that, Mr. Dibdin's suggestions being so very important to the gas industry generally, he hoped they might receive very careful consideration from the members of the Institute. He was afraid, from the tone of some of the author's remarks in the first part of his paper, that he had an idea that all did not desire the same end in this matter. His own feelings were that the only desire of everyone was to arrive at the most accurate method of ascertaining the true illuminating value of the gas supplied to the public. He was pleased to find that, in addition to his suggestions with regard to the photometer, the writer included some in reference to the rooms in which the instruments were to be used, because this was a matter of equal importance. The suggestion of placing the photometer in the middle of the room was probably a good one; but it greatly depended upon the system of ventilation adopted. Whichever form of instrument was decided upon, he hoped it would never have such a term applied to it as was now sometimes heard—that of a "conjuring-box;" and also that there might be

* Mr. Sugg at this point called attention to the question of the make of candles as bearing upon photometric results; and this matter was referred to in the course of the discussion. The 10-candle pentane argand standard was tested with two different makes of candles on the same day; and in one case its value was given as 10·4 candles, and in the other as 9·97 candles.—Ed. J.G.L.

only one recognized standard photometer. The only other point to which he wished to refer was with regard to reading the disc. If this was still to be dependent upon the eyesight of the examiner, he believed it would be unsatisfactory, for a great many operators did not see alike with both eyes. If, therefore, some arrangement could be devised whereby only one eye was made use of, he believed the results would be more reliable.

Dr. Stevenson Macadam (Edinburgh) said that he had listened with very great attention to the two papers; and, as an expert in the matter of testing the quality of illuminants, he had to thank both the authors for giving the meeting an opportunity of discussing this most important subject. He was not quite sure that he agreed with either gentleman. He certainly should have been glad if Mr. Dibdin had adhered strictly to the merits of the question to be discussed, and left out some remarks as to the manner in which the instruments could be manipulated. He agreed with the last speaker that they were all anxious to get at the truth, to improve the apparatus, and to have a standard which would be recognized by all parties as furnishing exact and reliable results. He had sometimes thought that this question of testing gas by the various photometers that had been introduced, was getting too complicated—that there were too many parts of apparatus, too many little things to be attended to which might possibly take away the attention of the experimenter from his main object, which was with his own eye to look accurately at the disc or at the index which would tell him the quality of the illuminant he was examining. If Mr. Sugg, whose many services in this direction they all acknowledged, could now begin, instead of adding to the apparatus, to take away from it, and make it more simple, they would probably get more readily at the desired result. It sometimes occurred to him (Dr. Macadam) that an analogy might be drawn between this kind of work and fishing a stream. He had been an angler all his life; and he had seen one man going out with a very simple instrument and catching fish, while others, with the most complicated apparatus, bound in brass, with gilded hooks, caught nothing. They must have a certain amount of experience and common sense when working with all apparatus; and he quite agreed that, whatever standard was adopted, whether pentane or candles—and he still thought a good deal of the candles—if a man were accustomed to work with a particular instrument from day to day he would get accurate results by it, whereas another, who was not accustomed to it, would probably fail. Great simplicity was very much to be desired. Ventilation also was most important. It did not matter whether it was a box or a room in which they were carrying on their experiments; but if they had draughts, these must interfere with accurate results. There was no doubt also that a very small proportion of carbonic anhydride, produced by the burning of either the gas or the candles, would begin to influence the lights; and if there were more carbonic anhydride at one end than at the other, there would be a tendency for the particular light that was there—whether the standard or the gas—to be lowered in illuminating power. Ventilation ought, therefore, to be thoroughly carried out; and one difficulty he had was to see how to have effective ventilation in a box, even if the experiment were only going on for ten minutes. In this interval of time, the operator himself if he were in the box, would get somewhat asphyxiated from the quantity of carbonic anhydride given off; and he (Dr. Macadam) therefore thought that, in this matter of ventilation, it was as well to have the atmosphere of the room to deal with, and to take care to have it properly free from draughts. They would then overcome many of the difficulties in testing. Another point to which Mr. Sugg had drawn attention towards the close of his paper was the difference in the various candles employed in testing gas. There was no doubt whatever that, making every calculation for the quantity of sperm consumed, there were differences depending largely upon the operator. It had been remarked that even their own eyes did not exactly agree. He was aware, for instance, that in his own case the left eye was the better of the two, and he generally worked with it; and, knowing this, an allowance should be made for it. If they had such a difference between the eyes of one man, they would have corresponding difference in the eyes of other men, and one man with the same candle might give a different reading to another. If they were accustomed to candles, he had always found they were a very good standard to work by. But, of course, they must guard against all possibility of variations occurring, and never test gas or any other illuminant when the eye was tired. There was a certain limit to the length of time during which they could look steadily and correctly on the photometer; and therefore in all trials, when he wished to be very exact, he commenced with his eyes perfectly fresh to the testing and did not carry on the work after they began to be tired.

Mr. Lewis T. Wright (Westminster) said he was exceedingly obliged to both Mr. Sugg and Mr. Dibdin for the very lucid papers they had read. Mr. Sugg's was more historical than otherwise; but it was none the less valuable on that account. It was necessary to know something about the history and development of the various forms of apparatus. One often saw modifications introduced, and did not quite understand the reason, because one could not get into the inventor's mind to know what it was which induced him to make it. From Mr. Sugg's paper, however, they would be able to glean some of the reasons which induced Mr. Evans to introduce the instrument which since about the year 1878 had been the subject of very much discussion. Mr. Sugg would be doing a further service to the gas profession if he continued his communications on what he had called the "ancient history" of the subject. He had referred to the gas in the Metropolis in 1857, which he said was supposed to be from 12 to 16 or 18 candles. He (Mr. Wright) took it that the 12 candles referred to the common gas, and the 16 or 18 candles to the cannel gas made at the Western Gas-Works. Then Mr. Sugg said that the rest of the Companies supplied what would now be called 13 to 14 candle gas, which he (Mr. Wright) took to mean that the 12-candle gas of 1857, if tested to-day, would be 13 or 14 candles. Now, he was under the impression that the difference was rather greater than that which was there stated. He might be wrong on this point, and Mr. Sugg right; and that gentleman might at some future time find it convenient to tell them the facts on which he had based his opinion. There had been certain modifications of burner since the date named; and the last was commonly supposed to have been equal to an improvement of two candles on the previous one. He should therefore have thought the difference between the standard of 1857 and that of to-day would be rather more than the one or two candles which the paper indicated. He believed that if Mr. Sugg looked into the matter—and he never spared any trouble on this question—he would be able to find the burners which were in existence then, and make comparative tests, so as to standardize those various burners; and this would be very interesting and important to the future generation of students of the gas manufacture. In many of the standard text-books they saw the results of the experiments made by Mr. Evans, Mr. Lewis Thompson, and other gentlemen; but these were made at the period when another standard burner was used which would produce a smaller amount of light from the same quantity of gas than the modern burner. They therefore wanted some factor, which he believed Mr. Sugg could give them, by which they could convert these old results into others on the basis of to-day. Unless this were done, they were only likely to be misleading the gentlemen recently connected with the industry, and not acquainted with what had been called the "ancient history" of it. Mr. Dibdin, in his paper, intimated that the tendency was to revert to the old type of photometer—the open bar; and he (Mr. Wright) must say that, in this particular, he sympathized with him. Mr. Dibdin also said he had been "much amused at an account of certain experiments made, or rather supposed to be made, with the pentane argand standard of light." He (Mr. Wright) knew something about the account here referred to; and he must say Mr. Dibdin could not have read the paper, or, if he had, he had forgotten all about it at the time he wrote his remarks. This could easily be proved. In the first place, Mr. Dibdin said the instrument was used in almost every way except that in which it was intended to be used—which he understood to mean that it was not used in the proper manner. Now, this was not correct. He was the person responsible for the paper, and he therefore spoke with some authority on the subject; and he stated therein very distinctly that, when the conditions under which each standard was fed with the illuminant were identical with those laid down in the instructions,

and it was acting normally, they did not agree with each other. What should have been said was that the instrument was employed in almost every way "in addition to" —not "except"—that in which it was intended to be used; and he (the speaker) claimed the right, not only for himself but for every scientific investigator to make such variations. It was impossible to carry out any experiment with a definite aim without varying the conditions. This was the essence of scientific inquiry. It would not have been at all necessary to make any variations had the instruments been correct; but when they were tried according to the instructions, and it was found they did not always agree with each other, then it was necessary to find out what was the cause of the variation. In order to do this, it was necessary to make a certain number of experiments, in some of which the conditions were exaggerated in one direction, and in others in another direction. Only by such means could scientific inquiry be conducted. The variations were not due to deviating from the instructions, but were necessary experiments as a consequence of the standard having varied when used according to the instructions. Then Mr. Dibdin thought another sentence in the paper referred to was a powerful argument against the Evans photometer, and, as he said, condemned it. But it was a curious thing that the whole of the passage in the paper which was adduced for this purpose contained in the middle of it an important statement which could equally condemn the other photometer —the open bar—if Mr. Dibdin's logic were sound. It said that when two standards which had differed to the extent of 8 per cent. on the Evans photometer were placed on the Letheby photometer, they were found nearly equal in both positions. Mr. Dibdin said they agreed. What he (Mr. Wright) said in the paper was that they were nearly equal. As matter of fact, they were not equal, but nearly so. Then it went on to say that when another standard was compared with the second standard in the Letheby instrument, they were found to be equal in one position, but differed 0·8 of a candle in another—that was to say, a difference of 8 per cent., which was equal to 1¼ candles on 16-candle gas. So that Mr. Dibdin's argument, that the record of these experiments condemned the Evans photometer, equally condemned the open bar. Mr. Dibdin's paper did not deal with standards, but with photometers. Mr. Sugg's, however, dealt with standards of light; and he thought he should be in order in pointing out why it was that the 10-candle pentane standard was not constant and invariable. The quantity of pentane which was being consumed, and which was the basis of comparison, was not measured actually. It was a fortuitous quantity, inferentially and approximately determined by measuring the height of a certain flame. Now, suppose the quantity of illuminant (the pentane) being consumed in a certain time were maintained perfectly constant, would, he asked, the length of flame on various occasions, in various positions, and in various parts of the room, be always the same? It was evident, if the atmosphere were heavier on one day and rarer on another, that the height of the flame would be altered; and in the same manner, if a current of air were passing in a particular manner, it would also draw out the flame. Consequently, for the constant supply of illuminant the flame-length would not be a constant quantity. Now, the basis of this standard was the converse of that—viz., that for the constant length of flame the quantity of illuminant consumed should be constant, which, of course, did not follow. If the flame-lengths produced by the same quantity of illuminant varied according to atmospheric and other conditions; so, if the flame-length were constant, the quantity of the illuminant would vary under similar conditions. The scientific gentlemen who were responsible for the use of a candle which was said to be six to the pound, took the precaution at least to satisfy themselves that the quantity of sperm compared should be on the basis of the fixed quantity—viz., 120 grains. But, in the case of pentane, there was no such fixity of basis. It was a fortuitous thing, dependent on the length of the flame, which might be affected more or less by the condition of the atmosphere and other interfering influences.

Mr. W. Carr (Stalybridge) said he had used the Evans photometer for a great many years without finding the variations of which Mr. Dibdin had given so striking an account in the paper; and he was rather surprised at his statement. He was reminded of a case where an open bar photometer was used in a room in the basement of a Town Hall, which was considered to be a very suitable place for a dark room, because it was in the centre of the building, with no possibility of any light getting to it. Unfortunately, there was very little possibility of ventilation, and that was only through the doorway. It was a long narrow room, and the gas was at the farthest end from the door. He always found that the results of testing in the room were very much against the gas; and he was satisfied that it was owing to the wretched ventilation, although the cubical capacity was great, and it would seem, on the face of it, that there ought not to be anything of that sort. Another point of importance, to which Mr. Sugg had referred, was the want of uniformity in the burner and apparatus for testing—a want which was felt a great deal more in the Provinces than in London. He believed that the matter was pretty well settled in the Metropolis, and that London gas, as supplied by the different Companies, was all very nearly the same, because the testing was carried out so carefully by men of wide experience, that the slight differences alluded to pretty accurately described the real differences that existed in the gas tested. In the Provinces, they found that some people could supply 20-candle gas which was not so good as other people's 16-candle. It was sometimes said to them: "Oh, you charge so-and-so for your gas; but just look at the quality! We sell gas of such-and-such a quality." In another place, where the price might be a little lower, it was said: "Oh, but your gas is not so good." Much of this arose from the fact that there was such a large amount of discretion given to the people who supplied the gas, as to the kind of burner and the apparatus they should use in testing it. It was, he considered, the duty of Parliament to settle this point; and he hoped some day it would do so. But as works were gradually getting into the hands of corporations, the duty of determining the quality of the gas generally rested with the consumers, who had to do a considerable amount of grumbling, when, as they often alleged, the so-called 20-candle gas supplied was of such a quality that one could not see to read or write by it. He agreed that if the apparatus were simplified, it would be a great deal better. He knew from experience that it required a man of fair education and intelligence, who should have had considerable training and practice, to make accurate tests with any of the bar photometers—either the Evans or any other—as now supplied. He did not know that very skilled practitioners found any difficulty in dealing with these instruments; but those who were not practised in the use of these things were rather hindered than otherwise in their operations by the multiplicity of appliances connected with the photometer. Very often the quality of gas was determined fairly satisfactorily by much simpler methods.

Mr. J. Abady (Messrs. Alexander Wright and Co.) said he was diffident in venturing on the few remarks he had to make, because, in coming after such photometrical giants as had preceded him, he felt somewhat as David must have done when he sallied forth against Goliath. With regard to the very much discussed question of the relative merits of the Evans and Letheby-Bunsen photometer, it appeared to him to be pretty generally admitted that it was possible in an Evans photometer, by opening and closing the doors, to affect at will the illuminating power of either the burner or the candles, while no one brought a similar charge against the accuracy of the Letheby-Bunsen photometer. It therefore appeared to him to be the sensible course to throw over the Evans photometer, and adopt the Letheby-Bunsen as the sole standard instrument. This had been the course always advocated by his firm. As to the desire expressed by several speakers for a simplification of photometers, he had been experimenting in this direction for some time on behalf of his firm, and he hoped shortly to bring forward a scheme for a simple photometer and room, with a proper system of ventilation &c., which would surpass anything that had ever been done in the direction of simplicity. A point was raised by Mr. Dibdin with respect to the pentane standard. He (Mr. Abady) did not know if any members of the Institute were present during the discussion of a paper read on the subject of the pentane standard by Mr. Dibdin in that room some few months previously; * but, as far as his (Mr. Abady's) memory served him, it

* See *ante*, p. 222.

was then claimed that the Dibdin 10-candle standard gave an invariable light of 10 candles throughout a long range of temperatures and of barometric pressures. Mr. Dibdin, however, evidently now admitted that the comparatively slight difference in the ventilation and temperature between an Evans and a Letheby-Bunsen photometer would account for the variation found by Mr. Lewis T. Wright; and this being so, he (Mr. Abady) ventured to say that the previous claim as to the invariability of the pentane standard made by Mr. Dibdin must fail.

Mr. F. G. Dexter (Winchester) desired to thank Mr. Dibdin for the very able paper he had read, which had enabled him to see more clearly than he did before he entered the room, the reason for some discrepancies which he had found, and which he could not explain. Some years ago, he had to make tests with the Evans photometer; and he found variations for which he was quite unable to account. In other years, he had to use an open bar photometer, and had occasion to repeat these tests almost identically; and the curious fact was that he was not then troubled with the same difficulty in obtaining uniform results. Whether or not it was due to ventilation, he was unable to say. This appeared to be the probable explanation, especially in connection with the use of high-power lights in very small places. There was one remark made by Mr. Dibdin in connection with the recording of readings upon which he should like to have a little more information. Some time ago, he (Mr. Dexter) had a number of experiments to carry out in conjunction with another gentleman; and as they were of considerable importance, they decided to take their readings independently. For a time, although they exercised the greatest possible care, they could not agree in their results; but subsequently this was found to be due to the fact that the other gentleman, when he had two readings coming together of the same quantity, ignored the second reading, because he considered it was expressed by the value of the first. The result was, of course, that the mean of the whole number was affected; and as soon as he corrected the method of recording the readings, they agreed fairly well. Now, in connection with the use of the punch on the paper scale, mentioned by Mr. Dibdin, it occurred to him that a difficulty might arise. If the point of the punch happened to penetrate exactly the same spot on the paper the second or third time, how could they determine the number of readings of a certain value which had to be taken into account? They could not tell just how many punctures belonged to one reading, and how many to another; and they would be unable to get a true result. He was very glad to find that Mr. Sugg had mentioned the influence of the draught of chimneys on argand burners, as it bore very closely upon some remarks he should have to make in his own paper later on.

Mr. J. Stelfox (Belfast) said he had listened with very great pleasure and benefit to the papers and discussion. He must confess, having had a lengthened experience of photometry in past times—perhaps not so much recently—that he had never been quite able to satisfy himself that the photometer was a standard he could very closely depend upon. He had done his best, by making two or three successive experiments on the same gas, using the utmost care, and trying to divest himself of any preconceived notions, but he must say he had failed to make the experiments correspond by more than tenths of a candle; and when he had seen reports of gas companies being fined because their gas was said to be 15·9 and not 16 candles, he often wondered how such absolute accuracy could be obtained. There were many elements of difficulty. Mr. Sugg had referred to candles, and admitted that there was something like $\frac{1}{8}$ candle difference between two sets. In a case of that sort, where the illuminating power was hovering on the brink of the standard, it was evident that the result might depend upon the particular candle used. Another source of error he believed was a personal one. People did not like to be accused of colour-blindness. But there were very few who were absolutely free from some slight tendency of this sort; and he thought it was very difficult sometimes to discriminate as to the point at which lights were equal, owing to a slightly different tone or colour to which one reader might give more weight than another. Dr. Macadam said they should not look at the disc, but at the indicator. But he thought the suggestion of having an indicating pointer was not a bad one, because the operator ought not to have his mind biassed by the fact that he saw, or knew, that the disc was at a certain place. He was apt, if he found it was not quite up to the right standard, to think there was something wrong, and so push the disc back and try again. With regard to Mr. Dexter's question, he thought Mr. Dibdin had clearly pointed out that the paper was to be moved along at each reading, which would avoid the difficulty referred to. He thought it would be very wise for those who wished to arrive at a correct result to carefully make the observations without being aware of what they had recorded until they came to read the result afterwards, because, as he had before suggested, there was always a tendency, if things did not seem to be going right, to try and even them up, and if they found a little discrepancy in the reading, it was almost impossible to avoid being influenced by it. He could not think any photometer would be completely satisfactory in which the candles were made to move, because he knew the influence of even a very slight draught was important. Even the passing of a person through the room would create enough draught to influence the consumption of sperm, which would go on at an increased rate for some time before it settled down again; and this itself would be sufficient to vitiate a whole series of observations. Like several other speakers, he wished to have something that could be depended upon, because if they had not an instrument by which they could check their observations and make them correspond under similar conditions, they did not take nearly so much interest in their work. They felt that it had to be done; but it was performed in a perfunctory kind of way. They had not the satisfaction which they would have if they felt assured they were making an absolutely accurate determination of the material being tested.

Alderman Miles (Bolton) said if there was one question in regard to gas manufacture and distribution which gave rise to more heartburnings than another, it was the quality of the gas supply. While agreeing that everything should be done to render the standards acceptable to both suppliers and users of gas, he ventured to take another view of the case. He thought that, on the whole, photometers might be considered fairly reliable; at any rate, they were the instruments specified by Act of Parliament, and were in existence. He hoped he might be forgiven for saying that, in his opinion, the results as given to the general public were often very misleading. He did not say that engineers and managers of gas-works wilfully tried to mislead the public as to the quality of their gas; but he thought most of them would agree with him that eight out of ten of the public did not believe the gas with which they were supplied was of anything like the quality it was stated to be. If consumers were told that they had a certain quality of gas, they said: "How do you test it?" and he must say he was astonished at the absolute ignorance of the public generally as to the methods by which the quality of gas was determined. He had been met with the observation from really intelligent men, when he told them that the gas was tested according to Act of Parliament and was of so many candle power: "Well, what sort of candles are they?" At the same time, he thought gas managers were not careful enough to let the public know that what they were supplying was a genuine article. How often was it the case that in the reports of gas companies and corporations they found it stated: "The quality of gas for the year was 20 candles exactly." But there were no data given upon which the assertion was made; and, of course, such general statements were not satisfactory to the consumer. London gas was probably the most severely tested gas in the whole world; and yet they never heard the people of London say a word about its quality, except occasionally in a leading article in one of the newspapers—and he admitted that they were woefully ignorant upon the subject. In his opinion, the people of London were generally well satisfied that they were getting the quality of gas they were supposed to have. If more towns and cities were dealt with in a similar manner, there would be greater satisfaction. So much had he been imbued with this feeling, that in Bolton he had determined the people should know that what they had was exactly the right thing. They set out to make 18-candle gas; but if the engineers tested it, and reported upon it, would the public be satisfied? Certainly not. Weights and measures, and all kinds of articles, as well as foods and drugs, were tested, in the interest of the public, by independent authorities; and it appeared to

him that gas ought to be tested in the same way. His Committee had, therefore, adopted the following system: They were not compelled by their Act of Parliament to employ a gas analyst, but they did so; and although he was paid by the Committee, he was perfectly independent. His instructions were to test the illuminating power and purity of the gas so many times a week at the gas offices nearly a mile from each station; and for this purpose an apparatus—the best that could be obtained—was placed at his disposal. It included a photometer of Mr. Sugg's manufacture, which was stamped by the Board of Trade in eight or nine different places, so that it ought to be correct. The Examiner could go morning, afternoon, or night—at any time he pleased—and examine the gas without any information from any officer of the Corporation; and he sent his reports to the newspapers, where they were regularly published before even they came to the knowledge of the Committee. In this way, he (Alderman Miles) contended that they had done their duty to the public; though he joined with other speakers in expressing the hope that by-and-bye they would have even more perfect instruments than they had at present.

Mr. C. S. ELLERY (Bath) said that undoubtedly it was necessary to be very careful in the manipulation of the Evans photometer. He had worked with both kinds, and knew something of the defects attending them; but his experience suggested that it was more difficult to get satisfactory results with the Evans than with the open bar photometer. The chief difficulty was the arrangement of the ventilation. As Mr. Sugg had practically admitted, the doors must only be closed just as the test commenced, because the ventilation would serve for only about nine minutes, so as to give a reliable test. In addition to this, where the curtains were in use, it was not only a trial of the accuracy of one's vision, but also of temper—to have to work in a close atmosphere, and make a series of tests with one's head enveloped in a curtain. He referred to this as a point to be borne in mind when considering the relative merits of photometers. Mr. Sugg, by his figures, had informed them that, in testing the pentane standard with different candles, he arrived at a difference of nearly half a candle; and here was another source of difficulty in arriving at exact results. When the instrument itself required such delicate handling, and the candles from different manufacturers were found to vary to the extent stated, it was tolerably easy to account for discrepancies between a gas company's returns and those made by an official tester. It was most important that this should be brought out, because many people failed to understand why the results should not agree to the lowest decimal point. As they had two such experts present, he should like to invite an expression of opinion on the existing method of making corrections for barometric pressure and temperature. This had been brought home to them with all the more force lately, since the barometer had been standing very high for so long. Now that they were going to the third place of decimals in photometric experiments, and improvements were being discussed in other directions, it seemed to him that, in testing the illuminating power of gas, it would be as well not to lose sight entirely of the method in use for making these corrections.

The PRESIDENT said one of the objects which it had been thought it might be possible to serve by asking Mr. Dibdin to read such a paper as the one he had given, was to endeavour to get some lines laid down upon which a standard photometer might be constructed which could be universally adopted throughout the country. They wanted one standard instrument, a model of each part of which should be deposited for reference in the Standards Department of the Board of Trade; and that those instruments should not be varied for a considerable period. Nothing very satisfactory would be done in connection with photometry until Parliament or the Board of Trade stepped forward and established once for all what a standard photometer should be; placed it in the Standards Department; and provided that, from a certain date, every photometer should be made in accordance with it. It was useless for manufacturers to improve on this or that part of the instrument; it only made the matter more complicated, and rendered it more difficult to determine which was the best one to use. There were already a dozen or more well-recognized forms which might be employed, each one of which differed very largely from the other, and probably brought out different results; and if the effect of their discussion that day was to lead to the introduction of one uniform standard, it would have served a purpose much to be desired.

Mr. DIBDIN, in reply, said that he was glad to hear the President bring the matter back to the point from which they had started; for the discussion appeared to have become somewhat discursive. His subject was "A Standard Photometer." But they had been wandering up and down, talking about everything else. Many observations had been made which seemed to support his general proposition—that a perfectly open bar photometer was preferable; but the discussion had been very bare upon this point. Whether candles were good or whether other standards were good, bad, or indifferent, had nothing to do with this particular question. Mr. Beale commenced by referring to the subject of the standard; but though this had occupied a good deal of his attention, it was not the question he had dealt with in his paper. The differences of eyesight in various observers must, of course, be taken into consideration. He had had many opportunities of noticing that there might be very great differences in the discriminating power of the eyesight as to tints and colours, and they might have positive colour blindness; and yet some observers so affected had been able to read a disc as satisfactorily as those whose eyesight had been proved to be far above the average. There was a power of accommodation in almost every eyesight which enabled the observer to swing the disc first one way and then the other until he brought it gradually to the middle position; and an average of a series of observations of this nature would agree wonderfully closely with those of observers whose eyesight was totally different. At the same time, he did not mean to suggest that observations should be taken under the most adverse conditions of eyesight. In the case of the London gas examiners, they were all submitted to most careful test as to the delicacy of their eyesight—a test which many experienced observers, friends of his own, simply repudiated, and refused to submit to. Still all the candidates who were examined had to pass such a test; and he believed they were a body of men whose eyesight was by no means the least sensitive in the country. Dr. Macadam had evinced his anxiety to get at the truth; and he (Mr. Dibdin) thought that in the wording of his paper he had made it perfectly clear that what they wanted was to get at the fundamental thing—to take away all the top hamper, and all outside considerations of this kind. They wanted an instrument which would give the truth as nearly as possible, and stick to it. Mr. Wright had started off with a discussion of the pentane argand standard; and, of course, he was entitled to refer to it, as it was mentioned in both papers. But he (Mr. Dibdin) had only alluded to it as a question of photometry. He had no wish to run through the mass of experiments that had been made by Mr. Wright on previous occasions, and explained by him; but he could not help thinking, while Mr. Wright was speaking, of the story of the negro phrenologist who, when he found the gentleman whose head he was examining had not a bump in a particular place, very soon raised one. Mr. Wright's experiments seemed to him rather in that direction. If the pentane argand was not wrong under certain conditions, he said: "Very well; then it shall be wrong," and it was done. However, this was not the time to discuss the question; and he did not propose to do so. He had been working at it for ten years, and had obtained certain definite results. The Board of Trade Committee on Standards of Light, on which were representatives of The Gas Institute as well as the most eminent authorities of the day, examined the standard, and confirmed his results; and they had been confirmed by many others. The Board of Trade Committee having reported definitely in favour of it, he had finished with it. It was for them to accept it or reject it. Mr. Wright said it was a bad standard; that it had certain faults; and so on. He (Mr. Dibdin) was glad to find there was someone who had worked with it sufficiently to find out its faults. Nothing in this world was perfect; and he had never heard of a standard, or proposed standard, which was beyond suspicion under certain circumstances. Mr. Wright would have done good service if he could have shown that, under certain conditions, the standard was not reliable. If the members of the Institute generally approved of it as being the best standard, it was at their disposal to use it; if they did not find it so, they might reject it. He was not prepared to enter—and he did not

think any good would come from entering—into a discussion on the matter, as if he wanted to force a pet proposal on them. He did not care one jot whether they used the standard or anything else. As a photometrist, he had done his duty in the matter, and had added his mite to the general question; and he was now prepared to sit down quietly, and leave the matter to the Institute and to photometrists generally. He had not the slightest doubt that many other gentlemen would take up the question of the pentane argand, and between them all would put it in its right place. Where that right place would be, he would not pretend to prophesy. He could only say his experiments were made honestly, straightforwardly, and with the best assistance—and he had had the opportunity of obtaining the help of gentlemen who had spent a large portion of their lives in connection with photometry. There he left it. If Mr. Wright wished to see the way in which they worked the pentane argand, he (Mr. Dibdin) would be only too delighted to show him at any time. He had laid down a proposition, and proved it up to a certain point; and now he had done with it. He thought there was a little confusion of ideas with regard to the effect of temperature on the pentane argand and on candles in the Evans photometer. The principal point with regard to the effect of temperature on the pentane argand was this: Under a high temperature, they had a more rapid evolution of the pentane vapour, which would put the flame up considerably. But they could check the consumption, and turn the flame down to the normal height; and they would then get the same amount of light passing under the screen that they had with the lower temperature. In the same way, if the flow of pentane through the carburettor were at a very low temperature, the rate at which the pentane vapour was given off would be reduced, the flame in the burner would fall, and they would get less light. But they would open out the regulating cock, and with less pressure they would have a larger aperture, and the flame would be restored to its normal height. The effect in an Evans photometer was a different thing entirely. Mr. Dexter had referred to independent readings, and to the result of punching a spot on the same place. But Mr. Dexter had evidently not followed the details which he (Mr. Dibdin) had read, because he had pointed out that each impress of a series of ten readings should be made to fall on the paper scale at positions a little lower than the previous one, so that the order in which they were made could be seen at once. There could be, therefore, no confusion. Mr. Stelfox seemed to think that occasionally a gas company was fined because their gas was 15·9 instead of 16 candles. This might be so in the country, though he had never heard of such a case; and, as a matter of fact, in London they were allowed half a candle grace. He understood that proceedings were never taken for only 0·1 candle. In London, the Companies were always allowed a full half candle; and they took very good care to have it. If they were 0·1 candle within the half, they were excused; and quite right too. But they must have a line somewhere. Alderman Miles had remarked that the London gas was the most thoroughly tested in the world. He (Mr. Dibdin) thought so too—at the stations. But the quality of the gas was not always the same in the districts as it was at the stations. Of course, London was a pretty big place. He noticed that Alderman Miles's gas examiner was in the happy position that he could go into the station and test the gas how and when he liked. In London, they had, if called upon, to give one full day's notice to the Gas Companies that they were going to test the gas—mentioning the time—and there must be an hour's interval between the testings; and the Companies were entitled to have a representative present. This was very pleasant for them; because, if the first test came out below the standard, they could telegraph at once, and it might be all right before the next testing. Mr. Ellery had referred to the Evans photometer, and the opening and closing of the doors. But he (Mr. Dibdin) would like to ask if any gentleman could point out where they would find any instructions that, to use the Evans photometer, either the right or the left door should be open, or either of them shut, or both shut or both opened. This was the fatal thing about the Evans photometer. It was admitted by everybody that they had differences, whether they opened or shut the doors; and yet there was no instruction anywhere to leave them open, partially open, totally closed, or dealt with in any way. There they were for the gas examiner to do what he liked with them. The last point referred to was the correction for temperature and pressure. This he always understood was a correction for the volume of gas consumed. Under changed atmospheric conditions, they might have considerably less volume than 5 cubic feet being passed as 5 feet, which, of course, was an injustice to the company that was put right by a correction for temperature and pressure. On the other hand, if they had more than 5 cubic feet being passed, and it was called 5 feet by the measuring instrument, this would be corrected in the same way. There could not be any question that a correction for the volume of the gas was a fair one. It would not be fair to the gas manufacturer to take the gas he had measured at one temperature at so many cubic feet, and expand it by exposing it to a higher temperature, and then measure it and test it. It would appear very poor gas indeed, simply because it had been stretched out like a piece of india-rubber. How far the effect of temperature and pressure affected the amount of light given by a burner or by candles, was another point, which was very important as a matter of scientific inquiry, but not important, he thought, practically; and he himself always held that the correction for temperature applied to the volume of gas but not to the light *per se*.

Mr. Sugg said Mr. Dibdin had gone over so much of the ground that it would not be necessary for him to detain the meeting long. The first and most important point as to a standard photometer was that, as the law stood at present, it would not be easy to make one which would be exceedingly simple—say, an open bar photometer to be used in the middle of a room. The reason was that, with the existing standard of light—candles (and they were not likely, it seemed, to have another standard yet), a company working under the Gas-Works Clauses Act might be fined on the result of two experiments. The Act prescribed that the result should depend on the average of the tests made. It did not say that there should be three experiments. Two only might be made; and a company might be fined for being 0·1 candle below the standard. This might arise in consequence of some reflection from the walls of the room on the wrong side, or something in the variation of the candles, or anything of that sort. This showed that they must have a very accurate instrument; and it was the very fine point to which the testing of gas was carried under the Gas-Works Clauses Act that obliged the photometer maker to endeavour to produce a photometer which would always be correct without being affected by such accidental circumstances. The Gas Referees were known to be thoroughly impartial; and they took precautions that the meters should be absolutely correct, so that the quantity of gas used in making the tests should be properly measured, and that there should be no unfairness in any way by which the quality of the gas might be affected from extraneous sources, but that its true value should be given. This was why black velvet was used in the Evans photometer, to prevent any reflection coming from one side to the other. There might be some differences of opinion as to how much ventilation there ought to be in the room or in the photometer; but these difficulties were not to be overcome by simply putting down a 2-foot rule and standing a disc in the middle of it. There were a great number of conditions which had to be carefully attended to, even with regard to the measurement of gas. He was glad to hear Mr. Dibdin say that, under the Gas-Works Clauses Act, they must take into account the temperature and the barometric pressure; though it had been stated by a witness in the House of Lords the previous day that no such correction was required. He (Mr. Sugg) said it was required, because the Act specified that the gas was to be accurately measured; and if this was to be done, they must allow for temperature and pressure. Mr. Ellery had said he found curtains objectionable. If so, he need not have them. A great many engineers, both at home and abroad, used the Evans photometer without curtains. In the case of the Gas Referees' new photometer—the Tooley Street pattern—one of them had curtains. At some of the other testing-stations, it was absolutely necessary for curtains to be provided, because the light from the walls came directly into the photometer, and hit the disc on the candle or gas side; thus adding 0·1 candle or more to the light on the particular side which it favoured,

amounting to 1·6 candles on 16-candle gas. This was why screens and curtains were introduced into the photometers—to prevent any accidental circumstances unjustly affecting the gas, and to ensure the steady burning of the candles. If they had, as in Paris, to perform thousands of experiments before a company could be fined, a 2-foot rule, or even a bit of string, would do. But when they come to such an exact point that a company might be fined for being 0·1 candle below the standard, it was necessary to take every precaution to prevent errors. Mr. Dibdin said they were never fined except for half a candle; but in his (Mr. Sugg's) opinion they were sometimes proceeded against for a very much smaller deficiency. Mr. Carr had made some observations with which he quite agreed; and Alderman Miles told them pretty much the same thing—that the public were not satisfied that they got the quality of gas stated. This was, generally speaking, their own fault. They did not use proper burners; and, of course, they did not get the value out of the gas. They might use one burner which would give a very different result from another in illuminating power with the same quantity of gas. With regard to the testing of gas in London, it was, he believed, the most rigorous in the world. Mr. Dibdin, in his reply, had said he found the gas all right in the stations, but not outside. This was all very well; but he (Mr. Sugg) understood that Mr. Dibdin went round and tested the gas after it had passed through large dry meters. He understood, for example, that Mr. Dibdin went to Board schools, where they had perhaps an 80-light dry meter, and when they tested the gas, there might be only 5 cubic feet passing through the meter.

Mr. Dibdin remarked that in such cases they took care to light up nearly all the burners in the place.

Mr. Sugg said this certainly made it more fair; but at the same time, if the gas passed through the meter, it was not giving the gas its best chance. At the testing-station, it was brought direct from the main.

A SEASON'S EXPERIENCE WITH INCANDESCENT PUBLIC LIGHTING.

By Fredk. G. Dexter, of Winchester.

In November, 1894, the writer had the honour of bringing before the Southern District Association the results of the previous twelve months' working of twenty public street lamps fitted with the Welsbach incandescent light. The publishing of this trial—the first record of the kind in this country—led to a good deal of criticism, and still more correspondence (the latter still continues unabated); and the undoubted great interest the question has excited, leads the writer to place before the members an account of more recent and much more extensive experience.

It often occurs that when some innovation—some departure from the beaten track—is decided upon, there is no better incentive to success than "necessity." The mother of invention may not give birth to one particular idea to the influence of which stumbling blocks dissolve and crooked paths straighten; but she will at all times stimulate the effort, and, in fostering the determination to succeed, gradually remove petty difficulties until the strengthened position sickens failure of the contest.

It has been the writer's good fortune to be favoured in this way. For twenty years, oil lighting had reigned supreme in the streets, at a cost of £2 2s. to £2 5s. per lamp per annum inclusive (lighting all the year round). The average power of the lights varied between 8 and 10 candles, and could be pushed to 12 candles.

With 15-candle gas, 4-feet burners required to be used to compete in any way in point of cost; but the illuminating result was not looked upon as an improvement—neither was it. With 6-feet burners, the improved illumination was sufficiently pronounced to disarm the criticism of those prejudiced in favour of oil, or against the supposed quality of the Gas Company's commodity; but friends and foes alike felt the desirability of preventing any important advance in the rates, and that the increased illumination available was insufficient to warrant the corresponding increase of 50 per cent. in the cost. At the same time, the feeling in the city for improved street lighting was growing stronger; and those members of the Corporation anxious to introduce electric lighting, of course availed themselves to the full of this feeling to promote the idea that this advantage could not only be secured by the introduction of electricity, but at no greater cost, and with the further boon of introducing a powerful weapon to the hands of gas consumers to compel concessions in price and improvement of quality.

Under these circumstances, it will be understood how the feeling grew that the time was ripe for a determined effort to recover the Company's true position and status. The greatly increased duty per foot of gas developed by the Welsbach system, afforded the only solution at disposal, and therefore compelled closer attention, interest, and desire to succeed in overcoming such difficulties as might present themselves than probably would otherwise have been the case. Want of enterprise has been very evident, in the tone of many of the letters that have been sent to the writer; and if these remarks to-day appeal to any in the "fit of the cap," it is hoped that the experience recorded may incite to greater effort.

The success of the experimental lighting secured the contract for one of the Parish Council districts; and this was shortly followed by the contract for three years for the city lamps. The total represents altogether about 500 single lamps, and 15 refuge lamps containing two lights. Though interfering somewhat with the continuity of the text, it is felt that the methods adopted and conclusions for so doing will be better expressed in the following sections under the respective heads, in order to facilitate reference.

Services and Standpipes.—These, as may have been inferred, required to be put in, in almost every case. The sizes used have been ¾-inch up to, and including, the bend at the base of the column, and ½-inch standpipes. The smaller standpipe is used as the area in relation to the velocity of the gas, for a Welsbach light is practically in the same ratio as the area of a ¾-inch pipe for an ordinary burner.

The standpipes terminate with a tee-piece; and immediately above this, but below the bottom of the lantern, is fixed a nose-cock or pet-tap. A short piece of brass tube runs up through the base of the lantern, to carry the burner. The object of the tee-piece is to provide means to force the service or inject liquid by unscrewing the plug and closing the pet-tap above, without interfering with the burner. The pet-tap has a secondary object, referred to under the head of regulation.

Lanterns.—During the eighteen months of the experimental trial, chimneys alone were available for public lamps. The bulb form of light, with metal reflector, had not been introduced. With the use of chimneys, it was found absolutely necessary to baffle the ventilation of the lanterns, so as to render them more windproof—not only to stop the pulse in the light caused by every breath of wind, but also because of the injury to the mantle.

This was successfully done after some investigation, although it is to be borne in mind that the terms of agreement did not permit of the introduction of special lanterns or even new ones; but the ordinary 14-inch street lantern, as used for the oil-lights, had to be utilized. Immediately the glass bulb form of burner was introduced by the Incandescent Company, the writer felt convinced that it would prove a great improvement; and this opinion was expressed in the former paper referred to. Its practical bearing in relation to choice of lantern, is the fact that it is no longer necessary to trouble about baffling. The bulb is sufficiently wind-proof in itself to work satisfactorily in any form of street lantern without alteration; and they have been used in this way for the whole of our contract.

Burners and Bye-Pass.—Of the two kinds of burner made, with and without bye-pass, the writer has no hesitation in saying that the bye-pass is the only practical form. The bye-pass jet saves its cost many times over in the ease and rapidity of lighting, the value of the warmth in stopping the deteriorating effect of damp on the mantle, and the longer life afforded by the absence of all shock in lighting. The Incandescent Company recommend and advertise a bye-pass burner specially made for street lighting. It is, perhaps, rather stronger than the ordinary household "C" bye-pass burner, and is fitted with anti-vibration springs and a double lever with chains.

This burner is considerably larger than the ordinary "C" burner. Experience proves, however, that it is unsuitable in the majority of cases, as its length, with bulb and reflector, precludes its use in the ordinary 14-inch lantern; and the travel of the long levers it is

fitted with is so great that the provision of room for this lifts the burner too high in all but the larger lanterns. The use of chains, also, to actuate the lever, is a great mistake; as if they are brought down together through the central opening, they intertwine and cause confusion; and if taken through independent holes the cost is added to, and the lantern rendered unnecessarily draughty. The chains also, on a windy or very dark night, are very difficult to catch with a rod from the ground.

The ordinary "C" bye-pass burner has been found considerably the better from every point of view; and the writer's original expedient for working the bye-pass lever from outside the lantern, by means of a stiff brass wire hooked into a hole drilled at the end of the short lever, and allowed to hang down through the central corner of one pane in the bottom of the lantern, and terminated just below in a disc of metal about the size of a halfpenny, has been found by far the most handy, simple, and inexpensive arrangement. To avoid keeping the plugs too tight, the addition of a small pin and counterbalance weight on the opposite side to the lever and rod has been found an advantage.

Chimneys and Bulbs.—Choice in this matter should not be delayed by a moment's hesitation. The glass bulb arrangement is immeasurably superior to any kind of chimney. The writer felt at the outset that the ordinary glass chimneys then available would never stand exposure in street lanterns. More recently the greatly improved "Jena" chimney has been advocated; but it will be seen later that even these bear no comparison with the life of the bulb. Glass-rod chimneys were tried, and failed in every lamp within a week, besides invariably destroying the mantles through the rods bending over and twisting into them. Mica chimneys were used for twelve months, until the bulbs were introduced; but while avoiding fracture, they gradually discoloured and became opaque in patches wherever a blowhole in the mantle permitted the flame to impinge.

Apart from these points the general inferiority of chimneys may be gathered from the following considerations:—

Firstly, in the case of a partially fractured mantle, the escaping jet of flame will with a glass chimney not only bring the chimney down, but cause the destruction of the mantle, and perhaps the rod as well. With mica, while immediate failure is averted, the opaque patches shortly become so great a disfigurement and obstruction to the light that renewal is necessitated.

Secondly, the draught of the chimney is much sharper, and causes a greater wear and tear of the mantle—especially after a fracture is once started.

Thirdly, in cleaning, the close approximation of the diameter of the chimney to that of the mantle leads to frequent damage of the latter when the chimneys are removed and replaced.

Fourthly, the chimneys require special attention to the lanterns, to maintain a steady light. With the bulb, the glass is too far removed to suffer from the jet, however defective the mantle may be. This fact, and the lessened draught, permits a longer run per mantle. Cleaning is facilitated without risk of damage; and no special arrangements to the lanterns are necessary. The cost of the bulb arrangement is greater, but the difference is more than covered in the lessened renewals of twelve months' working.

Mantles.—Under this head, it is desired to point out that the Incandescent Company send out on application a special mantle for street-lighting purposes.

Vibration.—It is probably correct to say that this difficulty has been the cause of a greater number of failures in the attempts to utilize the Welsbach burner for street lighting, than all other considerations combined. In the writer's opinion, however, many records of failure might have worn a different aspect with continued perseverance, and some attempts to introduce other methods than simply those provided by the Incandescent Company. The vibration is set up from two independent sources. The one (and the most difficult to master) is the tremor set up in the metal service-pipe and standpipe from the vibration of the ground by the passing traffic; and the second is caused by the impact of the wind upon the lantern, and to some extent the post.

The Incandescent Company's anti-vibration burner has its upper part supported upon springs. In one form, there are four very small vertical springs working on guide-rods; and in the other form, one larger diameter conical spiral spring. The mantle is so light that the slightest movement will affect it. The first arrangement of four springs is far too stiff to be of the slightest benefit. The second expedient is sufficiently sensitive and elastic to keep up a continual quiver some time after the cause of disturbance has passed. It therefore continues the shake of the mantle after it would of itself have come to rest, and appears to be responsible for more breakages than it is intended to cure.

Vibration needs to be cut off or deadened before reaching—but not at—the burner. To deaden the tremor of the service-pipe, the writer's plan of packing the column with sawdust, and the use of a soft rubber collar at the neck to keep the pipe central, has proved very serviceable. It is also most beneficial in preventing interruption from frost. In the more severe cases, the burner may be suspended in the lantern by a cup-and-ball joint, or else the device of Mr. Redman, of Bradford, adopted, consisting of a rather larger diameter spiral spring fastened to the top of the lantern, from which depends a frame carrying the burner, &c. The gas connection is effected by a small rubber tube to the standpipe. This arrangement is not particularly sightly; but it is certainly successful.

Where the burners are mounted on the standpipes, it is most important to avoid contact with the lantern at the bottom where the pipe passes through. The use of the brass tube at this point before mentioned is to allow plenty of clearance without too large a hole in the lantern bottom. From 1¼ inch to 1½ inch diameter holes, for the passage of the ⅜ inch pipe, is sufficient. This allows for all necessary ventilation (the rest of the bottom of the lantern being closed), and permits as much play as the lantern itself will stand in a gale, without jarring the pipe and affecting the burner. Attention is particularly drawn to this simple matter, as its non-observance has led to many failures. In the desire to keep the lantern tight (especially where chimneys have been used), the standpipe has either been made to fit tightly, or even been back-nutted up, with the result that every movement due to the wind is communicated direct to the mantle.

Regulation—Pet-Taps v. Governors.—You are probably well aware that the power of the Welsbach burner for lighting purposes depends upon the heating value of the bunsen flame applied to the mantle. The bunsen flame, while hot in itself, has little *radiant* power. It is therefore evident that, unless the mantle hangs in *contact* with the flame, the lighting effect is lost. The value of a fixed or constant consumption in the case of an ordinary luminous burner cannot be gainsaid; but the writer questions its utility in the case under consideration.

A Welsbach burner with a governor implies a fixed consumption, and therefore a flame of definite size. Its lighting value depending upon an absolute "fit" or corresponding size in the mantle, requires that this condition should be equally rigid. Experience proves that uniformity of size in the mantle is not, and cannot be, ensured, with the result that any one burner will give widely different lighting results with different mantles.

Recognizing this point, it has been found preferable to use the nose-cock or pet-tap before mentioned immediately below the bottom of the lantern; and to regulate the consumption by this under the evening pressure, to secure the maximum results with each mantle. That is to say, the pet-cock will be altered to obtain the highest photometrical result with each renewal of mantle. To prove the great importance of the slightest variation of consumption, your attention is drawn to the following results extracted from the table of experiments under the heading of "Draught:" A full-size mantle, with 4 cubic feet consumption, gave 80 candles with the bulb lamp for street purposes. Directly the consumption was lowered to 3 feet—a reduction of 25 per cent.—the light was reduced by 70 per cent., the photometrical value being 24 candles only. A reduction of another ½ foot per hour lowered the lighting value to 7 candles. You will be able to trace similar results in the table in the case of chimneys, and also with the plain mantle.

The converse results—viz., the loss arising from a *heavy* consumption with a *small* mantle—are not given in tabulated form, as this information has recently appeared in the

technical press and seemed to excite surprise, though it cannot fail to have escaped observation by all those who have given their minds seriously to the use of the Welsbach burner. It will be found from experiment that any rate of consumption giving a larger flame than the mantle employed, will result in correspondingly poor results. These considerations bring the writer to another phase of the question of equal if not greater importance.

Draught.—Not only will a positive increase of heating effect by increase of consumption in a Welsbach burner lead to diminished lighting duty through the want of application of the heat to the right place, but the same and greater loss will result by the influence of the draught of the chimney removing the path of the flame from that of the mantle. It has been pointed out that the use of the pet-tap is best adapted to provide for variations of the mantle where the supply of gas available will permit; but supposing the consumption to be fixed, as with the use of a governor or a short supply, and the flame is too small for contact with the mantle, the results can be improved by shortening the crutch a $\frac{1}{4}$ or $\frac{3}{8}$ inch, so as to bring the mantle down into the flame. This method is, however, inferior to that of regulating the draught.

Questions have recently been asked as to what is the influence or value of one chimney compared with another. This may be answered with the statement of the fact that a rule for the size and length of the chimney cannot be laid down so long as there are variations in the quality of the gas burnt, in the rate of consumption, and in the size of the mantles. With full consumptions of (say) 4 feet and large mantles, the draught with the bulb arrangement or the 10-inch chimney is not too great. As the rate of burning is reduced, the draught is not reduced in anything like the same ratio, with the result that it becomes in excess. Such excess causes a diminished or more concentrated flame, which, burning inside the mantle and more out of contact than if it were too large, is practically useless.

Experience with these burners proved that a reduction of the air supply by the partial stoppage of the bunsen holes, enabled the flame to lift and again come in contact with the mantle. The writer has, however, found that far better results are obtainable by checking the draught at the chimney. The following table of tests has been compiled to show this influence:—

A Series of Photometrical Tests with the Welsbach Light to Prove the Influence of Draught and Consumption.

[Values in Standard Candles.]

	Arrangement of Burner.	Rate of Consumption per Hour.			
		4 C. Ft.	3 C. Ft.	2½ C. Ft.	1½ C. Ft.
	Plain	80	70	32	3
No 1	With bulb and enamelled iron top	80	24	7	1 (*a*)
2	Do., and 2 bunsen holes closed	..	40	18	No effect
3	Do., and 3 „ „ „	..	45	28	„ „
4	Do., with bunsen holes open, but chimney checked	..	75	54	8 (*b*)
1	With 10-in. choke chimney	80	13	7	1 bare (*a*)
2	Do., with 2 bunsen holes stopped.	..	24	..	No effect
3	Do., „ 3 „ „ „	..	28	..	„ „
4	Do., „ holes open and chimney checked	..	75	54	15 (*b*)
1	With cylindrical 9-in. Jena chimney	80	54	28	3 (*a*)
4	Do., but chimney checked	..	75	54	15 (*b*)

Notes.—All results are with 15-candle gas, and the same mantle and burner and same standard.
Corresponding marginal numbers give corresponding conditions.
"Plain" means without any form of chimney.
"Chimney checked" means stopped in more or less degree at the top, to secure maximum results for each rate of consumption or shape of chimney.
Remarks.—(*a*) groans; (*b*) noise stopped.

It will thus be seen that the Welsbach burner requires the draught to be carefully adjusted, not merely to secure the maximum results, but to avoid heavy loss under certain conditions. These results, while true for this particular mantle, would not be accurate for another mantle differing in size. The values are not ultimate, but relative.

Maintenance.—In the matter of maintenance of the street-lights, the record is favourable—in fact, more so than the estimate provided. By the test meter the average daily consumption works out to 38 cubic feet per light, including bye-pass. The bye-pass consumes, with a flame ½ inch long, ⅛ foot per hour. This represents 1000 cubic feet per lamp per annum. The average consumption per light, when in use, works out to 12,900 feet per annum, or about 3⅝ feet per light per hour. The lighting is continued all the year round, from the average times of one hour after sunset to one hour before sunrise.

The mantles have worked out to an average of three per lamp per annum; but bearing in mind the absence of frost last winter, the writer believes that four mantles per light is more likely to represent average conditions. The breakages of bulbs and forks average one-half each per light per annum. The fractures of "Jena" chimneys used on the double lights in the refuge lamps, have been at the rate of two per light per annum.

In the matter of cleaning, it may be said that the lanterns require less attention than with the ordinary flat-flame burner. This partially results from the lessened air supply necessary to support combustion, and partly from the absence of the free carbon deposited by the open flame on windy nights. The principal enemy of the Welsbach light is dust. This accumulates on the top of the gas-nozzle, and upon the gauze above. If allowed to remain, it prevents the passage of the necessary air into the bunsen holes, causing incomplete combustion, an elongated yellow tinged flame, and very poor lighting results. By checking the unnecessary draught to the burner before explained, this deposit is materially reduced, and the amount of attention necessary minimized. The number of lights attended to per man averages 85.

These remarks close my subject. The Welsbach light is undoubtedly one of the greatest aids to successful competition that the gas industry has ever experienced. Its influence, while reducing the relative cost of light, has advanced the consumption of gas all over the country by the increased satisfaction of the existing consumers and the attraction of others. The writer feels that its influence should not be confined to the house. It is capable of meeting every competitor in the street, from cheap oils to arc lights, in cost and in effect; and it is hoped that the foregoing experience may lead many others to seek its aid and to realize its efficiency.

Discussion.

Mr. T. N. Ritson (Kendal) expressed his thanks to Mr. Dexter for his paper upon a subject which was very interesting to all in the profession, more especially now that they were more and more confronted with electricity for street-lighting purposes. He had opened up a subject which seemed to clear away a little mystery which had attached to the incandescent system of lighting—viz., the trouble given with reference to the draught of the chimneys. When in Glasgow recently, he noticed that in the street-lamps there they had abolished chimneys altogether, and adopted the bulbs to which, he presumed, Mr. Dexter had alluded; and this appeared to be a very great improvement. He had noticed, in using incandescent lights in his town, that the chimney was one of the principal sources of trouble. If they had glass, it heated and bent over; while mica scaled and became dirty. These glass bulbs, however, seemed to be exactly the thing wanted. The wind was a very serious factor in street lighting; and manufacturers of lanterns ought, he thought, to give more attention to the question of making them absolutely wind-proof, so as to prevent the breakage of mantles. The introduction of incandescent street lighting was one of the greatest advances of the day; and they must all hail it with satisfaction.

Mr. J. Stelfox (Belfast) said he had only had a short experience of incandescent lights in public lamps, having fixed about 150 of them; and he had chosen situations where his large gas-lamps ended, so as to bring the light gradually down to the others. Up to the present time, he could not report so favourably as Mr. Dexter had done as to the cost of maintenance; but something might be due to the fact that the streets of Belfast were somewhat shaky, and there was a great deal of vibration. He might say, however, that a considerable amount of damage seemed to have come from direct contact with the lamp-posts; and they had had a great deal of breakage, not only of mantles but of bulbs. So far as they had gone, their cost for maintenance from all these sources came to something like 3d. per lamp per week, or 13s. per annum. They did not

expect that the Gas Department would derive any profit from the transaction; but they were satisfied to go to this expense to ensure a good light, though 13s. was a large slice off the £2 12s. 6d. allowed for street-lamps. Mr. Dexter had expressed a doubt as to the effect of the spring arrangement for protecting the mantles; and he (Mr. Stelfox) might say that one of the agents of the Incandescent Company, with whom he was discussing the matter, said that they had obtained much better results in Dublin without the springs. Being on the spot where the mantles were manufactured, they had thought it unnecessary to put them through the dipping or strengthening process essential for carriage, but fitted them on direct, and obtained very good results. The fragility of the mantle seemed to militate more against the successful use of these burners in the streets than in shops and dwelling-houses. He regretted this, for he had advocated their use from the beginning. They had been largely taken up in Belfast for internal lighting, and had given great satisfaction; and he only hoped that in the future they would be equally successful in the streets.

Alderman MILES (Bolton) said he wanted to make a few remarks on the paper, because he thought he could tell the members something which would enable gas managers in all parts of the country to apply the incandescent system with almost perfect success. There was no question about it that, in the face of the electric light, their manifest duty was, if possible, to improve the lighting of the public streets. With this view, he took the matter in hand in Bolton, and tried a few incandescent burners, which were put in the worst parts of the borough—that was to say, where there was most traffic, and consequently the most violent vibration. He first tried the lights where there was considerable omnibus traffic, as well as a good deal of general traffic, including heavy lorries and other vehicles. He had stood beside the lamps more than once, and, when an omnibus passed, he had noticed a mantle absolutely dropping to pieces before his eyes. So frequent had the renewals become, that the expense was very serious; and they were therefore obliged to take the lanterns down, and put them in side streets where there was less traffic. A few weeks previously, however, his attention was called by the agent of the Incandescent Gas-Light Company in Bolton to an invention which he had just perfected, which gave most startling results. He called on him at his place of business, where he showed him the invention, which, he believed, was patented. It was attached to an ordinary 14-inch lantern put on a post in the shop, and it carried a mantle which had been in the lantern for about two months. The agent allowed him to strike the post as violently as he could, or drop a heavy weight upon the floor close to it—in fact, to do anything he pleased short of damaging the mantle itself; and this he did without producing any perceptible effect upon it. He then got the agent to make the appliances necessary for the half-dozen lamps in use; and they had then been in operation for three weeks, and the mantles were as perfect as they were when put up. They had tried the springs recommended by the Incandescent Company; but, with all respect to that invention, he found it was of no use whatever. Vibration ought to be guarded against horizontally and in every other direction; but the spring only provided against perpendicular vibration. The invention he had referred to guarded against it in every direction. He had a photograph of the fitting which he would hand to the President, and would endeavour to describe it. It consisted of a piece of ⅛-inch brass pipe, which was taken from just under the bottom of the burner nearly to the top of the chimney. It was then wound round three or four times in a spiral form, and brought down again to the bottom, where it was turned up, and the burner was placed upon the point. It was very simple, and could not get out of order. The lantern could be lifted out of its place for cleaning just as easily as by the ordinary arrangement; and the whole cost was only a few pence. They must remember, in listening to Mr. Dexter's paper, that the city he was referring to was Winchester, which he (Alderman Miles) should describe as an aristocratic, quiet, rather sleepy kind of city—very different from some of the large towns in the North. In Lancashire, they had very heavy traffic to contend with; but he believed the appliance he had described would answer in any possible position. He should be pleased to give every information regarding the invention to anyone who would communicate with him.

Mr. J. BOOTH (Southport) said he had had some little experience of incandescent street lighting. About two years ago, when the first installation of electric lighting was introduced, his Committee asked him to put up a few incandescent burners in juxtaposition with it; and he at once communicated with the Welsbach Company. They carried out his instructions; and when the installation of the electric light was opened, and the incandescent burners were lit, it was said that the electric light was not equal to the other. At that time he pointed out to the Company that he did not think their mantles would stand the vibration of the streets. The result had proved he was correct; for shortly afterwards the springs were introduced. He did nothing further in the matter till the beginning of the present year, when he introduced the system into several streets—in some places using double, and in others single, burners. To some of the burners he had attached a sort of annular cap of brass, and dispensed with the spring altogether; and the effect, on the whole, had been very satisfactory. There was a considerable saving in gas consumption over the ordinary burners; and the result was so successful that they intended to carry the system much farther. Though there was a great future for incandescent burners in private houses, he was quite sure there was also a great future for it in street lighting.

Mr. J. WEST (Manchester) said they were all pleased to find the incandescent burner making such rapid strides in connection with both public and private lighting; and he desired to thank Mr. Dexter for the valuable information he had given them, showing how he had overcome the difficulties he had had to struggle against. Perhaps, however, if he had to deal with some of the streets in Manchester and other larger cities and towns, where the traffic was heavy and the vehicles more numerous, the vibration there experienced might upset some of the burners he had in use. Some time ago, he (Mr. West) recommended that incandescent burners should be used for lighting a certain town; and a number were put up. But the vibration was too great for them; and the apparatus soon came to grief. They tried the springs; but they found these did not fully meet the requirements. He should certainly endeavour to avail himself of the method adopted by the writer of the paper, or of the invention Alderman Miles had described; for if either method was successful, they would overcome the chief difficulty the incandescent system had to contend with for public lighting. He made a large number of experiments some time ago as to the advantage of the incandescent burner with different qualities of gas; and he found that an ordinary gas of 15-candle power gave a light equal to gas of 20-candle power, each burner consuming the same volume. Those members who were in Scotland last year would possibly remember Professor Macadam went farther, and proved that they could get as much light from 15-candle gas as from 24-candle gas; thus showing that 14 or 15 candle gas was the most advantageous for incandescent lighting. He (Mr. West) had also introduced some of these burners in a works in Manchester—putting six burners in a cluster, and placing a very large reflector over them. He distributed them along the whole range of the shops—hanging them from the roof; and they had proved very successful. There were twelve clusters, which had been in use for four months; and they had only had to renew two or three mantles. There was a crane travelling backwards and forwards upon a gantry, so that there was considerable vibration, but not sufficient to do much mischief. A large number of engineering works about Manchester were adopting the incandescent system; and no doubt it would eventually supersede the electric light. With regard to the cost of cleaning, he should like to know if Mr. Dexter included cleaning the burners, or only the lanterns. He (Mr. West) could suppose that the lamps themselves would not require any more cleaning than an ordinary lantern; but he should imagine the burners would need much more attention.

Mr. J. LYNE (Wexford) said it would be interesting if Mr. Dexter, in his reply, would give, in pounds, shillings, and pence, the cost per lamp per annum, with details—such as the quantity of gas consumed and the price; the first cost of the lamp, burner, mantle, and appliances; the cost of maintaining them; and the wages for lighting,

extinguishing, and cleaning. Mr. Dexter stated that the consumption of gas by the bye-pass was ½ cubic foot per hour. This appeared to him (Mr. Lyne) to be a small quantity for a light to stand in the open air without getting extinguished. He should also like to know why a bye-pass tap of the usual pattern, and fitted with an ordinary lever for lighting, &c., could not be used, without having any special arrangement for the purpose.

Mr. DEXTER, in reply, said Mr. Ritson had referred to the important results obtained from using the bulb form of lamp. But he (Mr. Dexter) would draw his attention to the fact that, while the bulb did give a better result than the chimney, there was no doubt the influence of draught, to which Mr. Ritson drew attention, affected the bulb just as much as the chimney; and it would be found that they would have to take special precautions to see that the draught of the chimney or the bulb was carefully balanced to suit the size of the mantle and the rate of consumption. Mr. Stelfox had referred particularly to the damage occasioned to the mantles by heavy traffic coming in contact with the lamp-posts. In Winchester, they had several breakages from the same cause—in fact, more from that than from any other. But they generally managed to secure the names of the offenders, and made them pay for the whole damage. Alderman Miles had described an arrangement of what he (Mr. Dexter) might call a spring—for it was a brass pipe which acted just as a spiral spring curled round in such a way that it introduced the same anti-vibratory qualities that the spring did. Mr. Redman, of Bradford, had suggested a similar device; and he (Mr. Dexter) was quite sure it would repay them to study the arrangement carefully, and try it, or any other which presented itself for overcoming this difficulty. As to the traffic of Winchester not being so heavy as that of some of the business towns in the North, perhaps the ancient city of Winchester might be somewhat sleepy; but he could assure the meeting that the vibration they had under certain circumstances was very severe. At any rate, it was sufficient to smash the drains and the water and gas mains, because through the streets the heavy traction-engines, drawing three or four heavy waggons laden with bricks, were allowed to pass; and he thought that in a narrow street this was as severe a test as any ordinary traffic in a large town. He was confident that, if he were placed in the position of being the engineer to the gas-works of a large busy town, he should not have given up the idea of using the incandescent lights because of the difficulty of vibration; or, at any rate, he should not have given it up so readily as some had done. True, others had since taken heart, and were making fresh trials. He was sure the Welsbach burner was too valuable to put on one side because it caused a little trouble. They should not wait to see other people introduce improvements and get over difficulties; but, though it might lead to slight reduction in consumption, and possibly cause more trouble, they should by all means show that they were abreast of the times, and be ready to adopt anything which would aid them in meeting the competition of electricity. As Mr. Booth had said, the vibration was of more importance than any other matter. With regard to the question of cleaning, he had simply referred to the cleaning of the lanterns; and it was certainly easier to keep them respectable with the Welsbach than with the ordinary flat-flame burner. The cost of attending to the burner was included under the head of maintenance, quite apart from cleaning the lamp. With regard to Mr. Lyne's remarks, he was quite correct in stating that ½ cubic foot of gas per hour of 15-candle gas was sufficient to give, with the Welsbach burner bye-pass, a flame ½ inch long; and this was quite sufficient to withstand the heaviest gale in an ordinary lantern. He had had a case of a lantern being blown bodily off the post; but the light did not go out until the whole thing was smashed. It was very seldom that the bye-pass was put out; and when this occurred, it was owing to the corrosion of the nipple after many months' use. As a matter of fact, a very much less consumption than ½ cubic foot would be sufficient; but he mentioned this quantity to show what length of flame could be obtained with a very small consumption. He had not given financial details, because he was placed in a very exceptional position; and he did not wish to prejudice other people in any way. He had furnished the details of consumption, the wear and tear of mantles, the breakage of bulbs, and the cleaning of the lanterns; and gentlemen could apply these figures to their own particular cases, and ascertain what the cost would be. If he had given the prices charged, the figures might be used to the detriment of other towns—in fact, he had had letters complaining of the terms on which his Company were supplying the light. But, as he had said, he was in an exceptional position. They had had over twenty years of oil lighting in Winchester, with the probability of either this being continued or else of electricity being introduced. He was determined that, if possible, the Company should have a look in; and he had consequently put the price as low as possible. In fact, although the ordinary rate was 3s. 6d. per 1000 cubic feet, they did not get much more than 2s. 6d.—perhaps barely that—for the supply. Whether or not other people could adopt the same course, they must, of course, determine for themselves.

Society of Arts.—The Council of the Society have awarded to Mr. W. J. Dibdin, F.I.C., F.C.S., the Chemist and Superintending Gas Examiner of the London County Council, a silver medal for his paper on "Standards of Light," read before the Society early this year (see *ante*, p. 222).

The Recent Drought and the London Water Supply.—According to the report of Professor Crookes and Dewar on the quality of the Metropolitan Water Supply in the past month, the total deficiency of rainfall for the year is now 4·69 inches, or more than 50 per cent. on the average for the past 30 years. They state, however, that the results of their examinations show that the water as supplied is thoroughly and efficiently filtered, and that the condition of both the Thames and the Lea leaves little to be desired.

The Gaslight and Coke Company and their Residuals Sales.—As from the 1st prox., Mr. William George Blagden (who has hitherto traded as a Chemical Merchant in partnership with his son, Mr. Victor Blagden) will enter the service of The Gaslight and Coke Company, to be occupied "in selling the various products manufactured at the chemical works of the Company." Mr. Victor Blagden, in conjunction with Mr. Walter Waugh, are constituting a new firm—under the title of Blagden, Waugh, and Co.—who will carry out all contracts of the old firm remaining uncompleted on July 1, "with the exception of those made for account of The Gaslight and Coke Company, which will be completed by the Company itself."

The Electric Light in Lighthouses.—In view of the fact that the recent wreck of the *Drummond Castle*, with the attendant deplorable sacrifice of life, took place close to the great electric lighthouses of Ushant, and that the loss of the *Eider* a few years ago occurred close to St. Catherine's lighthouse on the Isle of Wight, which contains the most powerful electric light in this country, it was only to be expected that the inutility of this kind of light in fog should be brought under the notice of the President of the Board of Trade. This was done in the House of Commons last Thursday by a question put by Mr. G. W. Wolff, the member for East Belfast, who stated that the late Dr. Tyndall, Mr. John R. Wigham, and eminent shipowners and shipmasters, had expressed the opinion that the electric light was useless during the prevalence of foggy or hazy weather; and he asked whether the Board would withhold sanction to any further installations of the light for lighthouse purposes until an inquiry had been instituted. Mr. Ritchie made a cautious reply, as an investigation into the causes contributory to the recent calamity has been ordered. But he was able to give the honourable member this piece of information—that no electric light has been sanctioned for lighthouses for the past ten years.

The Damage to the St. Louis Gas-Works by the Recent Tornado.—The last number to hand of the "American Gaslight Journal" contains an illustration showing the condition of the East St. Louis Gas-Works on the 28th ult., the day following the terrible storm which caused so much loss of life and destruction of property in the district affected by it. When referring to this catastrophe in the "JOURNAL" for the 2nd inst., writing on the exaggerated information which had then reached us through the papers, it was remarked that something serious must have happened to the gasholder which was said to have "collapsed;" and this is confirmed by the particulars since received. The holder, which was 60 ft. by 20 ft., was lifted completely out of its tank; and one half of it, together with two columns and three girders, fell upon the roof of the retort-house, while the other half wrapped itself round the house like a blanket. The plant was literally torn to pieces. The scene must have been truly disheartening to the Manager of the Company (Mr. H. Maguire). But, with commendable promptitude, he immediately set about re-constructing the works; and, with the assistance of the Kerr Murray Manufacturing Company, he hopes to have the plant in a condition to send out gas by the 1st of July. The damage sustained is estimated at $15,000, exclusive of any allowance for loss of business during the whole of June.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1487.)

THE Stock Exchange last week was mostly occupied in the settlement of the account; and fresh business was decidedly limited. The opening was gloomy; and the general tendency was flat all round, owing to various disturbing influences, chief among which were the Cuban situation, Turkish affairs, and South African difficulties. Calmer views gained ground later on; and there was some degree of recovery, although the American market remained depressed. Cheerfulness was imparted by fine traffic receipts in home rails promising better dividends. So that, on the whole, prices in general come out rather better. The Money Market had the advantage of the usual demand for the settlement, and of the normal requirements at the close of the half year. The supply, however, was out of all proportion to any possible demand. In the Gas Market, there was a considerable restriction in business, quite as much as in other departments. In the earlier part of the week, there was some brisk dealing in Gaslight issues; and there was a fitful activity in Imperial Continental. But it died away when the account was over; and fresh business was almost *nil*. Gaslight "A" was in good demand from the outset, and was quoted a point and a half higher; but the prices at which stock changed hands never beat the best of the preceding week—314½—though they equalled it. The only secured issue dealt in was the 6 per cent. debenture, which commanded an advanced price. A few transactions were marked in South Metropolitans at good average figures—but nothing more. Commercials would have been quite stagnant but for a transaction in the debenture stock. The Suburban and Provincial group were just saved from inanition by some dealings in British at an increase in price. The Continental were about as active as most; and though they did not advance their quotations, they commanded top prices. Among the rest, Belgrano and Buenos Ayres moved up; the position of Argentine affairs in general being more favourably regarded. Business in Water was as quiet as it well could be, and prices were steady. A few quotations come out rather better *ex div.*

The daily operations were: Business in Gas opened favourably on Monday; but it never reached a degree of activity. Gaslight "A" rose 1½; and Buenos Ayres, ¼. Business continued at about the same pressure on Tuesday, and was mostly in Gaslight "A." Prices generally were good; but quotations did not move. On Wednesday, transactions dwindled away to small proportions; and again there was no change in values. On Thursday, there was a burst of activity in Imperial Continental; all else remaining very torpid. Gaslight 6 per cent. debentures fetched a nice price; and the quotation rose 2. Friday was a very quiet day, almost devoid of business; and nothing moved. Saturday, though quiet, afforded indication of a good firm tendency all round, and excellent prices were obtained. British improved ½.

ELECTRIC LIGHTING MEMORANDA.

The Case For and Against High Voltage Supplies—The Demand for More Light—Differential Charges for Electricity.

AT the recent meeting of the Municipal Electrical Association, Mr. Barnard, of Hull, read a paper on "Electricity Supply at 220 Volts," which would be a subject of particular interest to the members. The author expressed the conviction that engineers would gradually persuade consumers that it is to their advantage to be supplied at 200 or 220 volts; and the bulk of his paper was taken up with a statement of the reasons upon which such persuasion might rest. The advantages derived from working a central station at the higher voltage—such as the ability to supply twice as many customers as before—are generally accepted by electrical engineers; but the interest of consumers in the increase of pressure has not hitherto been so plain as Mr. Barnard endeavoured to make it appear. He argued that, though high-pressure lamps may consume 40 per cent. more energy in doing their work than the most efficient 110-volt lamp, the majority of consumers will prefer the former on account of its longer life. Experience at Hull is reported to corroborate this view. For one thing, it is stated that the higher voltage current is found to be much steadier than that of lower voltage, and is much less liable to be disturbed by the switching on and off of motors. Mr. Couzen, of Taunton, followed with a paper on the same lines; maintaining that the new system has marked advantage over that of high pressure alternating currents, with transformer stations, in regard to extensions of the service. In all cases, it was contended—and rightly, so far as the principle involved is concerned—that if by any means the capital outlay can be reduced, the consumer is bound to benefit thereby, if indirectly. Unfortunately for the completeness of the case thus sought to be made out for high-voltage currents, the question of the efficiency of the lamps remains. Mr. Jackson, of the Newcastle Company, remarked on this head that a 100-volt lamp is more efficient than one of 200 volts; and a 50-volt lamp would be still more efficient. He considered that a small candle-power lamp is necessary in order to compete with gas, which was a notable confession of weakness.

Electricians are not more enamoured of small lighting units than gas engineers; but their circumstances make them tolerate this painful means of keeping down the consumers' bills. What will they do when the cheap new pattern incandescent gas-burners, consuming less than 2 cubic feet of gas per hour, and giving a light of upwards of 30 candles, become as popular as they are certain to do before the coming winter? The opinion of other speakers at the meeting went to emphasize the dependence of electricity supply undertakings on lamps nominally rated at 8, and even 5, candle power. As a matter of fact, this reliance seems to be more of a last resource for meeting the requirements of economical consumers than anything else. Electricians will never fix a small incandescent lamp if there is the slightest prospect that the consumer will pay for a larger one; but regard for the size of the bills constrains them to recommend these dim arrangements for use in any position where the user can be persuaded to endure them. Thanks to the incandescent and other efficient forms of gas-burner, however, the householder is fast learning to improve the lighting of back halls, corridors, cellars, and other parts of his premises where there is much service traffic, or where dirt and other undesirable consequences of the reign of partial darkness have been apt to accumulate. There is obviously a greater chance of security, to mention only one consideration, when all possible lurking-places are kept flooded with light during the long winter evenings, than when the solitary candle in the hands of a wandering domestic was the accepted standard of illumination outside the reception-rooms. Whether they like it or not, electricians will have to make allowance for this progressive demand for light; and their so-called economical 8 and 5 candle lamps will soon be generally scouted as the miserable makeshifts they are. We are not now arguing against the employment of small-power lights of any description for decorative purposes by those who prefer a scheme of lighting which calls for them, but only to show the increasing weakness of the case advanced for them on economical grounds. If the 8-candle incandescent electric lamp ever truly represented the best that could be done in the direction of a "poor man's light" by this system of domestic illumination, it has fallen upon evil days. With regard to the supply of electricity at 200 volts, there remains the further question of the danger. Mr. Wordingham, of Manchester, admitted that his station could give such a service, if it were deemed desirable; but they are not in a position to force it upon customers. He had made some experiments with a 200-volt current on ordinary fittings, and the results were disastrous. "The remains of the fittings were exhibited to the meeting." He thought such a course of action might lead to serious trouble in shop districts.

There appears to be much more hope for the future commercial success of electricity supply undertakings in the cultivation of the commercial side of their affairs, than in fobbing off the consumer with a dingy lamp on the score of its comparative cheapness, or in increasing the voltage of the current to the danger-point. It is to the great credit of Mr. Wright, of Brighton, that he has perceived this truth, which, indeed, lies on the surface of the commercial history of gas supply. Where, as in France, a scientific pedantry has been allowed to formulate the conditions under which it supposed that the price of gas is susceptible of modification in the interest of the consumer, it has been found impossible to procure any sensible reduction of this price. In England, on the other hand, strict attention to commercial elements alone has brought the price of gas by successive reductions down to the lowest charged anywhere in the world. With the light of the latter principle for his guide, Mr. Wright has found his way to a remarkable set of conclusions respecting the method of charging for electricity supplies, which he enunciated in a paper read at the recent meeting. These conclusions—a round dozen in number—cannot be set out at length here. The eighth, however, which seems to give the theory of the matter, states that "the enormous cost of getting ready to supply electricity, compared with the cost of continuing to supply when ready, can be best realized by remembering that it costs two-and-a-half times as much to supply a unit to a consumer who uses his lights on an average only one hour a day, as it does to another who uses them three hours." Mr. Wright warns his hearers against the error that mere increase of business will be competent to repair the loss of supplying electricity to "short hour" consumers. It is different, as he points out, with electricity and gas supply; the lack of storage facility in the former constituting an element of radical importance. He makes out the case for differential charges upon what has become known as the Brighton system; and consequently his whole paper is highly suggestive.

The Secretaryship of the Institution of Civil Engineers.—Mr. James Forrest, who for so many years held this appointment, has retired; and Dr. J. H. T. Tudsbery, M.Inst.C.E., has been appointed his successor.

Gas Engineering Society.—We are asked by the Secretary of this Society (Mr. E. W. Weippert) to notify that at the next meeting, to be held at the Goldsmiths' Institute, New Cross, on the 8th prox., Mr. A. G. Bloxam, F.I.C., will read a paper on "Cyanides."

BOOKS ON THE GAS-ENGINE.*

As our title implies, although there are gas and air engines, of sorts, for engineers and others to make a study of—very properly and profitably for their readers—there is at the present day but one gas-engine for general use, and this is the motor with which the name of Otto is identified, and by which in technical annals it is immortalized. Yet, inasmuch as it is agreed by philosphers to be necessary to master the events of the past in order to understand the present and form a reasonable idea respecting the future, the thanks of gas-engine users are due to authorities in mechanical engineering, like Mr. Bryan Donkin, who will take the trouble to trace for them the origin and development of the motor which practically occupies the market and affords employment in the workshops of to-day. Hence it is no wonder that a second edition of Mr. Donkin's reliable work on the general subject has been called for; and it is only what might have been expected of such a faithful servant of the industrial public, that he has not been contented with making his new volume a mere reissue of the old, but has done his best to bring the matter up to date. As the author truly observes in his new preface, the demand for gas and oil engines has become enormous; and he briefly explains why this is so. These motors are employed for a great variety of uses, which are being extended yearly, as the great improvement of their performance by the ingenuity of modern makers—chiefly shown in greater regularity of working—becomes more generally recognized. It is now perfectly understood that the thermal efficiency of gas and oil engines is much greater than, rising to twofold that of the best steam-engines in the most favourable circumstances for both motors; and also that the former are at their best in the sizes, and under the working conditions, when the latter are at their worst. It is, however, not fair to the gas-engine to compare its thermal efficiency, in the small units to which it is usually confined, with that of the largest and most elaborate steam-engines. The thermal efficiency of a first-class modern compound condensing steam-engine of 600-horse power and upwards may, indeed, be only double that of a 30-horse power gas-engine; but the latter is far and away more efficient than the usual steam-engine of its own size.

As Mr. Donkin observes, the remarkable engineering and chemical fact to be noticed in connection with gas-engines is that they work (in tens of thousands) under conditions which at first sight appear impossible—that is, with explosions and red-hot flames at every second revolution. And yet no difficulty is found in the cylinders with respect to lubrication, valves, &c. He admits that the necessary water-jacketing of the gas-engine cylinder is responsible for the waste of about one-third of the heat of the fuel which keeps it going; but he cannot see any prospect of the advent of the much-desired hot-cylinder engine. It is the same with the rotary or "impulse" gas or oil motor, on the lines of the steam-turbine.

Mr. Donkin permits it to be seen that the history of modern gas-engine design, up to the period of the expiration of the Otto master-patent, was a tale of attempts by other engineers to overcome the alleged defects of the Otto engine, most of which were indistinguishable from devices for circumventing the patent. This appears more clearly from the general abandonment of devices to avoid using the Otto cycle which ensued at the critical period referred to, and the new direction thenceforward given to the skill and enterprise of gas-engine makers. Mr. Donkin speaks very highly of one of the latest improvements of the Otto engine—the "scavenging" arrangement introduced by Mr. F. W. Crossley and Mr. Atkinson, the value of which, he says, "can scarcely be overrated." He passes in review every pattern of gas-engine at present in the market; commending such as appear deserving of favour by the possession of any special merit.

Considerable prominence having been given in the technical press from time to time to the French gas-engine known as the "Simplex" (constructed by Messrs. Matter and Co., of Rouen), Mr. Donkin gives a chapter to it. He admits that of all modern competitors with the Otto engine, few have been so good in design or so economical in working as the Simplex. Curiously enough, among other distinctive features of French gas-engine design, preference for electric spark ignition takes a prominent place, whereas in England the hot tube is preferred for this duty. Owing to the generally high price of coal gas in France, producer gas is used for working engines; and as this kind of gaseous fuel can only be economically made on a somewhat large scale, the most successful gas-engines are on a corresponding scale of magnitude. Messrs. Matter prefer the Lencauchez gas producers for their engines; holding that for the immediate future it will be more profitable to attend to the improvement of gas generators than that of the engine.

Seeing how early French gas-engine design entered upon the industrial field, with the Lenoir motor, it is one of the highest testimonials to the worth of the Otto gas-engine that, on its appearance, it extinguished the Lenoir engine as then made, and eventually drove Lenoir to remodel his motor by adopting the compression cycle. A strong movement has been set on foot—under the auspices of the Paris Gas Company—with the object of popularizing the second Lenoir engine consuming coal gas; but Mr. Donkin has not much to say on the matter. He states, however, that a small vertical engine of the Otto type brought out by the Company is well made, and much used in Paris. In Germany, besides the Otto, the Körting is ranked by Mr. Donkin as a national gas motor. The Daimler motor is also well spoken of by this authority—more particularly as used with oil fuel.

Separate parts of Mr. Donkin's work are devoted to the subjects of oil and air engines; and in the former division the use of oil-engines for driving carriages on common roads is not overlooked. Valuable appendices to the book contain statistical information, lists of patents, and reports of engine trials of much importance to students of the principles and practice of gas and oil engine design. The high encomium we passed upon the first edition of Mr. Donkin's work equally applies to the second, "only more so."

Mr. William Norris, who indites the preface to his book from Lincoln, is unknown to us as a gas or mechanical engineering writer. He promises, however, to tell his readers all about gas-engines working on "the common and well-known four-stroke cycle of Beau de Rochas and Otto," as constructed by the leading makers; and it is therefore necessary to judge his present book by no low standard. He hopes his work "will be found of use, and supply a much-felt want;" and with this end in view, he assures the world that he "has spared no pains in seeking the most reliable and up-to-date information." He warns us at the start, however, that "only actual modern gas-engines are considered"—which almost looks as if he intended rather to compile a catalogue of manufacturers' wares than to instruct his readers in the why and wherefore of accomplished facts, which is so strong a point with Mr. Donkin. Mr. Norris either cannot have known Mr. Donkin's book, or he thinks lightly of it; otherwise he could not recommend his own as something to satisfy a "much-felt want." Of course, every author might recommend his book in the same terms; for nobody knowingly publishes a superfluous work, which is a piece of experience that cannot be obtained except by appealing to public opinion.

The limitations set to his work by Mr. Norris have the advantage of enabling him to plunge at once into the substance of his treatise. His style is not elegant, nor are the original drawings by which he illustrates his descriptions models of neatness; but it must be conceded that he knows the gas engine pretty well, as appears from the following passage:—

> Many people have had their faith in the value of gas-engines very much shaken because of want of practical advice in laying them down. Experience teaches that, in the first place, a considerable margin of power must be provided over and above that specified by the makers. Gas-engines will not work regularly and satisfactorily over a run of an indefinite length of time with the full specified load; and there is no doubt that the makers are mainly responsible for the disfavour with which they are often viewed, as they are repeatedly—no doubt driven to it by competition—recommending engines which will barely do the work required of them. There is a constitutional difference between the systems of obtaining power from a steam and a gas engine that places them on an entirely different basis. A steam-engine may be worked up to its test-load for almost any length of time, but not so a gas-engine. What is given off over a few hours' test must not be considered the working power of the engine; and if gas-engine makers will only acknowledge this practical fact, and fix a 'working load' for each engine, instead of the maximum brake horse power or indicated horse power as at present, they will soon rise higher in popular favour. The author's experience is that, with a load two-thirds of that specified by the makers, gas-engines work smoothly and well; but with anything over this, trouble is to be expected.

This, however, depends upon the kind of work put upon the engine, whether continuous or occasional—to say nothing of other considerations. The passage, as given, fairly indicates the character of the author's work. He is practical, writes from the standpoint of his own experience, and expresses himself candidly if somewhat awkwardly. The last consideration is not of great moment, of course, so long as awkwardness does not so run into obscurity of diction as to render the writer's meaning doubtful. So far as we have been able to ascertain, Mr. Norris manages to say clearly enough what he wishes to convey; but there is little pleasure in reading him, though he impresses one with the belief that he is a competent and honest guide in matters whereof he discourses, which is the main thing. He gives a handsome testimonial to the value of the Lanchester and Stockport starters, although he describes one of his own. We gather from this and other passages of the book that Mr. Norris has gained his experience in connection with the well-known firm of Robeys, of Lincoln. He undertakes to tell his readers all that it is necessary to know about fixing gas-engines for using town gas, and also instructs them concerning special power gases. He makes a slip—due probably to an oversight in reading the proofs—on page 200, in stating that "carbonic oxide is a very poisonous gas, and devoid of *colour*"—meaning, as appears from the context, odour. He praises highly the apparatus for making gas from oil and from miscellaneous animal and vegetable rubbish designed by Messrs. Mansfield and Sons. Although he states that the arrangement in question is "undoubtedly the longest lived and known oil gas apparatus system, and is in use nearly all over the world," regard for truth compels us to the confession that we do not know anything about the working of this particular "gas apparatus system."

* "A Text-Book on Gas, Oil, and Air Engines; or, Internal Combustion Motors without Boiler." By Bryan Donkin. With 154 illustrations and selected table of trials. Second Edition. Revised and largely rewritten. London: Charles Griffin and Co., Limited; 1896.

"A Practical Treatise on the 'Otto' Cycle Gas-Engine." By William Norris. With 207 illustrations. Longmans, Green, and Co.; 1896.

Then the author gets upon a gas-producing project of Mr. B. H. Thwaite, the operation of which is described in language too pompous to be Mr. Norris's own. Thus we read how "flame, in descending through the mass of fuel in the second vessel, raises the coal therein to a state of incandescence, and in passing *descensionally* (!) through this heated carbonaceous column of fuel, the products of combustion of the gases generated in the first vessel are reconverted into carbon monoxide and free hydrogen. The hydrocarbons of the fuel fed into both vessels are *either oxidized* or *burnt* by the supply of air, but the products of combustion are reconverted into C, O, and H, or if they descend through the incandescent column of fuel, they are split up by *thermolytic* action—the hydrogen being set free, and the solid carbon remaining to be converted into carbon monoxide." This is a pretty to-do about an arrangement that Mr. Norris cannot say he has ever seen working and driving an engine; and we advise him to confine himself in future writing to what he is able to vouch for by personal knowledge. With this reservation, we must repeat our commendation of Mr. Norris's work as being conscientiously done, and as constituting a handbook of the gas-engines actually in the market to-day, which engineers and power users will find useful in assisting them to make their choice of these popular motors.

NOTES.

The Ushant Light.

The recent disaster to the "Drummond Castle" near Ushant imparts melancholy interest to the articles upon French coast and lighthouse illumination by Dr. C. S. du Riche Preller, which have been appearing in "Engineering" of late. Dealing with the effect of hazy weather upon the visibility of lights, the author has determined that the luminous range of powerful lights rapidly decreases as their luminous power increases; so that a light of 5 million candle power in the Channel in average weather will have a luminous range of about 44 nautical miles, while doubling the power only gives a range of 5 miles more. In lights up to 1000 candle power, the ratio of luminous range in average weather to that in hazy weather is, broadly speaking, 1 : ½; while in lights of above 1000 candle power, it is approximately 1 : ¼. The nominal illuminating power of the Ushant light is 6,500,000 candles; and it is credited with a luminous range of 50 nautical miles, and a geographical range of 23 miles. This means that, whereas the optical power of the light would enable it to be seen in clear weather at the longer distance, geographical conditions prevent it being directly seen from a wider horizon than 23 miles, although beyond this its group-flashes would be observed illuminating the sky. Unhappily, the powerlessness of the electric light to penetrate fog or mist, allowed the "Drummond Castle" to run aground almost at the foot of the lighthouse rock.

The Production of Electricity Direct from Carbon.

A remarkable account has appeared in several American technical journals of an apparatus for producing electricity by the direct combination of carbon and oxygen, stated to be the invention of Dr. W. W. Jaques, of Boston, U.S.A. The result is described as attained by immersing carbon in a bath of fused caustic soda, and causing air to bubble through the liquid. In his patent specification, the inventor declares he has found that "if oxygen, whether pure, or diluted as in air, be caused to combine with carbon or carbonaceous materials—not directly as in combustion, but through an intervening electrolyte—the potential energy of the carbon may be converted directly into electrical energy instead of into heat." An arrangement of a generator upon this principle consists of a battery of 100 iron cells, each 12 inches deep and 1¾ inches in diameter. These were filled with caustic soda, and placed over a fire to keep the electrolyte in fusion. The cells were connected in series; and it is stated on the authority of Professor Chas. R. Cross, of the Massachusetts Institute of Technology, that a current of 90 volts and 16 ampères was obtained from a consumption of about 8 lbs. of the carbon electrodes in 18¾ hours. The heat used in the fusion of the electrolyte was not taken into account in this statement of the performance of the battery, nor was the amount of power required for blowing air through the fluid. Of course, both these duties should be performed by the battery itself, which would show the amount of disposable energy left for use in lighting incandescent electric lamps. The wonderful thing about the arrangement is that air and carbon should be caused to combine at the temperature of fusion of caustic soda—about 300° Fahr.—and that the thermal value of the carbon should so nearly be reproduced electrolytically in this way.

The Admixture of Kentish Rag-Stone with Portland Cement.

Nothing has been heard of late of the question that was raised in the portland cement trade last year as to the legitimacy of mixing ground Kentish rag-stone with cement. Recently a report by Dr. Michaelis, of Berlin, to the Secretary of the Cement Trade Section of the London Chamber of Commerce, has been published, which sets the question at rest. Those who used the rag-stone admixture declared that it rather increased the strength of the whole than otherwise; while the opponents of the practice denied that ground Kentish rag could in any sense be rightly termed a cement, or be anything else than an adulterant of the genuine article. It appears from the experiments of Dr. Michaelis, that the effect of the admixture is mainly a question of how the cement is tested. If the test briquettes are gauged neat, cement will stand a considerable addition of ground stone not only without deteriorating, but actually to its improvement. If the briquettes are made with cement and sand, however, the addition of ground stone makes them tell a very different tale in any instance. Hence, if the cement is to be used neat, that which contains a carefully considered addition of ground rag-stone will be in a physically better condition for such use than that which is not so "improved." As to the general application of sand mortars, however, Dr. Michaelis finds that the admixture of Kentish rag-stone diminishes by so much the amount of cementitious matter. He says that he cannot, therefore, defend the addition of Kentish rag-stone to portland cement intended for the market. The result goes to show the uselessness of testing cement in the form of neat briquettes, when it is intended for use in the ordinary way with sand as mortar or in the preparation of concrete. The report corroborates the known fact that a comparatively coarsely ground cement will give better results on a neat test than a very finely ground one; the relative positions being reversed when the samples are mixed with sand.

TECHNICAL RECORD.

SOCIETE TECHNIQUE DU GAZ EN FRANCE.

Annual Congress at Clermont-Ferrand.

The Twenty-third Annual Congress of the above Society was held at Clermont-Ferrand from the 16th to the 18th inst., under the presidency of M. DE LACHOMETTE. The following abstract report of the proceedings is translated from the "Journal des Usines à Gaz," the Society's official organ.

At the opening of the meeting on the morning of the 16th, there were 105 members present. The report of last year's congress in Paris having been adopted, the new President of The Gas Institute (Mr. C. Stafford Ellery) was, as customary, elected an honorary member. Then followed the admission of members and associates—there being 14 of the former and 10 of the latter. Allowing for deaths, withdrawals, and exclusions, the total number of members at the close of the year was 600, divided as follows: Honorary members, 17; ordinary members, 483; associates, 100. The contributions made to the funds of the Society by gas companies and firms amounted to 22,330 frs. (£893); being a slight increase as compared with the preceding year. The Treasurer (M. Deleury) submitted his report, which showed that at the close of 1895 the capital had increased to 170,693 frs. (£6828); being an augmentation to the extent of 5638 frs. during the twelve months. The retiring members of the Committee (MM. Bigeard, Coindet, Gardiner, Thibaudet, and Vautier) were then re-elected for three years; and the general business at the morning sitting concluded. The Committee afterwards held a meeting for the election of officers for the ensuing year; and the following was the result:—

President	M. Delahaye.
Vice-President	M. Vautier.
Secretaries	MM. Visinet and A. Lebon.
Treasurer	M. Deleury.

At the afternoon sitting, 160 members were present, as was also the Prefect of the Department of the Puy-de-Dôme. A report was, as usual, presented on the papers submitted in competition for the Society's premiums. One of these dealt with two subjects—the saturation of the caustic ammonia of ammoniacal liquor; and the inertness of purifying materials in presence of an illuminating gas deprived of ammonia. The idea was to remove from the gas, by the simple process of washing, the greatest possible quantity of carbonic and hydrosulphuric acids, especially the former. This idea, although correct, and supported by interesting experiments, was not followed up by results sufficiently conclusive to justify the Committee in awarding a prize to the author. Another paper dealt with the question of the enrichment of poor coal gas by means of heavy oils. It did not, however, contain anything new on the question; and therefore the Committee decided on depositing it in the Society's archives. In competition for the prize of 2000 frs., to be divided among persons who have effected some marked progress in the appliances used in the manufacture of gas, the corrugated retorts on the Teissier and Nègre system were submitted. But the Committee came to the conclusion that very long trials would be necessary to prove that this retort fulfilled the conditions set forth; and consequently they did not award any premium to its designers. With regard to the prizes for papers presented at the meeting last year, premiums of 250 frs. have been awarded to M. Godinet, for his note on "Condensation;" to M. Perthuis for his communications on "Cyanogen" and on "Heating by Electricity;" and to M. Ymonet, for his papers describing a method of sending gas into the holder by the outlet pipe in case of accident to the inlet, and explaining his system of promoting the sale of coke locally.

The usual prizes of 200 frs. each were awarded to aged foremen or workmen, for good conduct or long service. There were no less than 95 applicants—a higher figure than in any previous year; but as some of the men had given only 18 or 20 years' service, their cases could not be entertained. Forty awards were made, the ages of the recipients ranging from 27 to 78 years; and their periods of service, from 20 to 41 years—the majority, however, being about 33 years. Medals of honour and diplomas were also bestowed by the Minister of Commerce and Industry on six gas workers selected by the Society.

The technical portion of the proceedings will be noticed in subsequent issues.

WESTERN (U.S.A.) GAS ASSOCIATION.

The Annual Meeting at Chattanooga.

(*Continued from p.* 1396.)

A paper on "Municipalities *versus* Gas Companies: their Reciprocal Relations," was read by General A. Hickenlooper, of Cincinnati. The author commenced by expressing a belief in the inviolability of contracts, the supremacy of law, the governing of ignorance and superstition by wisdom and intelligence, absolute equality of taxation, the granting of permanent monopolies for the supply of permanent wants, and the granting of regulated monopolies for any public service that can be carried out better by private enterprise than by municipal agencies. After giving a definition of the various terms used in treating his subject, he pointed out that both municipalities and gas companies derived their powers from the same source, were amenable to the same laws, and were governed substantially in the same manner. The ratepayers centralized authority in their mayor and councillors; and the shareholders in their president and directors. So far, the legal status and public responsibilities were the same; but a divergency came in when the public lighting and the partial occupancy of the public roads was considered. The latter was an absolute necessity; and therefore the gas company could not be brought into existence without the concurrent action of the municipality. To some extent, the two were partners; and it was necessary that the interests of both should be properly cared for and expressed in an ordinance or contract, which may either be permanent or terminable at the expiration of a certain time. The law was a fixed command; and not only business ability, but legal knowledge, was necessary for the proper drawing up of such a contract. And after every care, no one could tell how the law might be interpreted. In the territory covered by the Association, there were 500 gas companies, operating under franchises granted under varying, dissimilar, and even contradictory conditions; and many of them dated back to a time when the industry was in its infancy. To this might be attributed much of the trouble and annoyance experienced in properly interpreting the contract obligations and reciprocal relations of municipal and industrial corporations, though it would be difficult to draft any contract that would stand the test of a legal interpretation for all time. The subsequent acts of the parties were usually considered conclusive in establishing the meaning of ambiguous terms. To give an example of the uncertainties of the law, he instanced a costly litigation that was necessary to establish the meaning of the word "lowest" in connection with the word "average;" and he pleaded for less legal talent and more common-sense in defining business relations. Field, the great law reformer, when he failed to secure through the legal profession the reforms he deemed necessary, turned with success to the Chambers of Commerce and Boards of Trade. No fountain could rise higher than its source; and no government could benefit the people beyond the limit of their intelligence. The people at large were at fault if incompetent men were elected to representative positions. The representatives of the public comprised plain, straightforward business men, representatives of the purely political element, and people with impracticable theories and visionary ideas of municipal reform. But the directors of gas companies did not exhibit this diversity, being elected entirely on account of business and executive ability. It was true, they were actuated by the hope of pecuniary gain; but as much might be said of many of the noblest enterprises that the world had produced. Much of the troubles between municipalities and gas companies arose from the restless and dissatisfied feeling that appears to be inherent in every human mind, and from the conflict of old economic theories of competition and multiplication of industries with the new ones of divisibility of labour and concentration of effort. There had always been opposition to the concentration of capital, and to the issue of regulated monopolies of any kind. Yet many of their opponents did not hesitate to support monopolies of various kinds in connection with labour questions—thus establishing the principle. A lecturer on behalf of a labour organization, had stated publicly that "the kicker at monopolies is simply kicking at the very means by which we have progressed out of barbarism." If the monopoly turned out a successful venture, then the masses wanted to share the profits—either directly or by enforced taxation or pecuniary concessions. They did not recognize that "it was the fitting reward of shrewdness and energy," and that the enterprise was attended with some risk. The American citizen required to be educated to the fact that independence was not to be obtained by destroying agencies of progress, or restricting industrial effort. No doubt, many abuses had resulted from combination and concentration; but they were all incidental, and not necessary, to such condition. Competition was not destroyed; but production was increased, and the costs reduced. The profits which the consumer regarded as taken from himself, came mainly from economy in working expenses and utilization of waste. As proof of this, he instanced the Standard Oil Company, which, of late years, had practically had no opposition; yet their prices tended downward. While maintaining that every gas company should be permitted to enjoy a monoply of its own product within its own district, he freely admitted that, without regulation, there would be danger of injustice to the public. Where granted, the franchise had always been accompanied by regulations as to the price at which gas was to be sold. The true functions of government were limited to the promotion of intelligence, care of the unfortunate, protection of life and property, and establishment of equality and justice. But directly it entered the domain of private enterprise, it interfered with the rights of the citizen to the disposal of his own profits, and forced him to pay a tax; and the one who had the smallest surplus, was the one most likely to suffer injury. Advocates of municipal ownership overlooked an important point. In comparing municipal with private enterprise, it must be remembered that the former was attended with a loss to the community, equivalent to the price which a private company would be prepared to pay, directly or indirectly, for the concession which was appropriated and enjoyed by the municipality. If the municipal venture was attended with profit, then the consumer was taxed for the benefit of the community; if with loss, the reverse was the case. So in any case there was an unjust burden somewhere. The only justification for municipal ownership, was that the service could thus be more efficiently or economically rendered than by private enterprise; and he asked whether anyone would claim that the affairs of municipalities were better or more economically managed than those of private companies. The position of those who decried industrial monopolies, while advocating municipal ones, was absurd and inconsistent; and nationalists did not appear to realize that the people support the government, and not the government the people. The author proceeded to show that the regulated industrial monopoly was not a concession to the company alone, but also to the municipality; and that the sale of such franchise was simply a means of increasing the cost of production and of taxing the consumer. Bonuses or taxes in any form put upon the company had the same effect. The true economic policy was to grant the franchise to the company that would serve the consumer on the best terms. Concessions for a limited term were open to the same objection—viz., that they did not tend to secure the lowest prices for the consumers, or the best construction, highest efficiency, and greatest economy in operation. It was the paramount duty, also, of any municipality to protect any company in their district which had raised capital on the faith of rights, franchises, or privileges granted to them, from oppressive enactments or destructive competition. In conclusion, it was pointed out that the power of control and regulation could not be properly exercised without detailed knowledge of existing conditions, which implied the right of investigation and inquiry; and this should be cheerfully conceded. There should be a system of public reports in such form and of such authority that their accuracy and official character could not be questioned. These would not only serve to correct false impressions, but also prove valuable for reference. The author advocated the appointment of a State Commission, comprising a gas engineer, a skilled accountant, and a lawyer, having a central office and laboratory, with the necessary staff of clerks and assistants. The expenses should be borne by the gas companies *pro ratâ*. The duties would be to collect annual returns, and to regulate prices, where necessary, on the basis of 8 per cent. profit, 2 per cent. depreciation, and 2 per cent. insurance; to apply the sliding-scale on the basis of an additional 1 per cent. profit for each 5d. reduction in price below the standard; and to protect the rights of all companies subject to attack. They should also have power to make inspections without notice, and to inflict fines and penalties for breach of contract on the part of a gas company.

Mr. Clark commenced the discussion by expressing approva of the points raised in the paper; but he thought it was for the municipalities, if they desired to go into business, to justify their position in doing so, rather than for the *onus* of proof to come upon the companies. Mr. T. D. Miller believed that some of the trouble about municipal ownership was due to the publication of incomplete reports, in which the items of wear and tear, depreciation, interest on capital, &c., were omitted; thus leading to a false idea as to the expenditure of gas companies. Many companies did not provide adequately for these items, and therefore showed, and deceived themselves with the idea, that the profit earned was larger than was actually the case. It must also be remembered that in new parts of the country there was a disinclination to invest money, and capitalists often came from a distance. Under these circumstances, they were entitled to a good return if they could get it. Opposition from a municipality to a private company, if carried

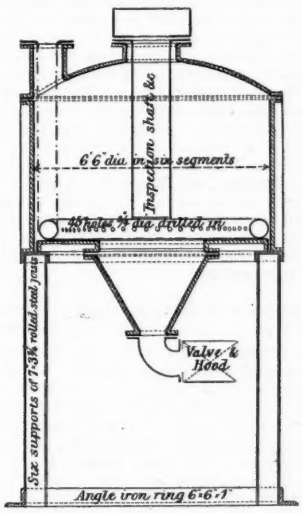
as far as the establishment of competing works, practically meant the confiscation of the company; and the company might actually be taxed to help pay the loss on its competitor. In some figures he lately got out, he showed that the cost of operating certain municipal electric lighting plants was more than half as much again as the actual tworking expenses; the latter being the figure quoted by politicians and others. He did not believe legislation could do much in this matter; as directly any attempt in this direction was made, the public looked on it as a bull does on a red rag. The best way of stopping the craze, was to educate the public. Mr. Kahn pointed out that this question of municipal ownership was simply one phase and one expression of popular perversities, nursed by false political economy, and by false political and social principles. There was not an industry in the States that had not suffered as much as, and he ventured to say a great deal more than, the gas interests by reason of this fearful mistake, which had crept into the courts, the legislatures, and the municipal councils of the country. In his own business, within the last three years 97 stove manufacturers had been ruined by the cannibalism of competition. It had been said that competition was the life of trade; but it was the death of profits. He suggested, not only that gas companies should combine with themselves, but also with other industries, to put down this serious state of things. Co-operative measures were absolutely indispensable and necessary. He pressed upon the Association the desirability of appointing a Committee to deal with the question on the lines he had suggested.

General Hickenlooper, in reply, urged that gasmen must not hold back, but step actively and aggressively to the front in the shaping of legislation. He instanced the success that had attended the gas interests of Ohio, which, led by the President of the Ohio Gaslight Association, had successfully resisted legislative propositions that would, if carried, have nearly ruined them. It would have reduced their dividends, and consequently the value of their capital, nearly one-half.

(*To be concluded.*)

MR. COLSON'S NEW SATURATOR.

When noticing, in the "JOURNAL" last week, the report of the Chief Inspector under the Alkali, &c., Works Regulation Acts (Dr. R. Forbes Carpenter) for the past year, we mentioned that Mr. Jackson, one of the District Inspectors, gave in his report an illustrated description of the new saturator designed by Mr. Alfred Colson, M.Inst.C.E., the Gas and Electric Lighting Engineer of the Leicester Corporation. We reproduce below the drawing and particulars supplied to Mr. Jackson by Mr. Colson.



It will be noticed that the saturating vessel, which is cylindrical in form, is elevated, and that the sulphate of ammonia as precipitated falls into a conical well at the bottom, whence it is discharged on to the drainer as produced, without the necessity for lifting the salt either by hand or steam. The main points where difficulty might have been expected in constructing this form of saturator—viz., the correct angle for the cone, and a suitable valve by which to discharge the salt—have been successfully overcome. Apparently, the simpler the valve the better. A copper disc worked by a screw in front of the discharge-pipe is adopted in this case. The saturator was designed to dispense with the labour of "fishing," and to prevent the escape of sulphuretted hydrogen and other gases. It is made of cast iron lined with lead, and supported by an iron framing. It has worked with the utmost success—no escape of gas having taken place; and the only labour needed is that required from time to time to adjust the discharge-valve.

REGISTER OF PATENTS.

Lamp Chimney Glasses.—Moeller, J., of Palmer Street, Westminster. No. 8213; April 25, 1895.

The object of this invention is to construct lamp chimney glasses in such a manner as to diminish their liability to crack. For this purpose, the patentee proposes to make the lower part of the glass, where it is subject to the greatest heat—extending from about the root of the flame to a little distance above its top, or above the top of an incandescent mantle, when such a mantle is used—not of circular, but of a kind of polygonal transverse section; the polygon having no angles, but presenting a number of rounded ridges and furrows, forming a corrugated or undulating circumference. These ridges and furrows, extending longitudinally along the glass where it is most heated, give freedom for local expansion and contraction. But instead of confining the undulations to the zone of highest temperature, they may be continued along the whole length of the glass.

Exhausters for Gas, &c.—Gwynne, J. E. A., and Ingham, J., of Brooke Street, Holborn. No. 12,026; June 20, 1895.

This invention has for its object to increase the quantity of gas pumped in a certain time, without materially adding to the dimensions of the machinery; and also to maintain at a more constant pressure the fluid pumped, as recorded by the pressure-gauge, than is done by the machinery commonly employed for this purpose.

Fig. 1.

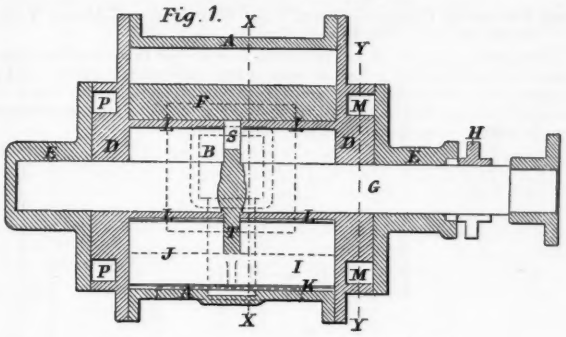


Fig. 2.

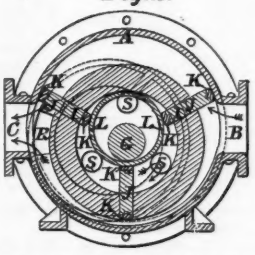


Fig. 3.

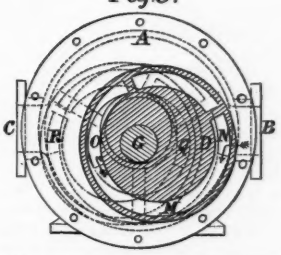


Fig. 1 is a longitudinal section of the exhauster; fig. 2 a transverse section (on a somewhat smaller scale) on the line X X; and fig. 3, a transverse section on the line Y Y.

The cylinder A is provided with an inlet-port B and an outlet-port C. The cylinder has ends or covers D, which may be formed separately and secured by bolts or other convenient means. E are bosses carried by the ends, and placed eccentric to them. F is a roller, the axis of which G is carried in bearings in the bosses E. H is a stuffing-gland, fitted into a recess in the boss E, forming a stuffing-box, which is packed to prevent leakage of gas or other fluid out of, or into, the cylinder. The roller F is turned so that a portion of its periphery is in contact with a portion of the interior of the cylinder; while the axle G is supported in the bosses E, and the ends of the roller are in close contact with parts of the inner sides of the ends D. The roller has three radial slots I planed out at equal distances apart, extending throughout the length of F; and accurately fitting these slots, are slides J, provided with nose-pieces or slips K and springs behind, to ensure close contact between these nose-pieces K, carried by the slides, and the interior of the cylinder, also between similar nose-pieces provided at the opposite edges of the slides and the outer surface of the projecting bosses or sleeves L, formed on or attached to the ends.

The roller F is bored out in its interior, so that its inner surface is in contact with the outer surface of the bosses L, while its outer surface is in contact with a portion of the internal surface of the cylinder. One cylinder end is provided with a port M, communicating through the opening N with the space between the outer surface of the roller F and the inner surface of the cylinder. The passage M also communicates through the opening O with the space in the interior of the roller. In like manner, the other end is provided with a passage P, which communicates with the interior of the roller through the opening Q, and also, through the opening R, with the space between the outside of the roller and the inside of the cylinder.

By means of this arrangement, the gas enters the apparatus by the inlet-branch B, one portion of which is carried by the slides J through the space between the outer surface of the roller F and the inner surface of the cylinder A, and discharged by the outlet-branch C; while another portion of the gas passes through the opening N into the passage M. Thence it goes through the opening O into the space in the interior of the roller; and passing from the end at which it was admitted into this space in the interior of the roller, through holes S in the diaphragm or web T forming part of the roller, towards the other end of the roller, it is carried by the slides J projecting within the interior of the roller to the opening Q, through which it passes

through the passage P, and thence through the opening R into the space outside the roller. From this, it is discharged through the outlet-branch C.

The slides J are so arranged that, at the instant when the gas is being carried under maximum pressure in the space between the exterior of the roller F and the interior of the cylinder A, that in the space in the interior of the roller is being carried by the slides projecting within the interior of the roller under minimum pressure and *vice versâ*. Thus there is a tendency to equalize the intensity of the pressure of the fluid within the spaces at any instant, so as to obviate sudden fluctuations in pressure. The apparatus may be run in either direction; the inlet-branch becoming the outlet, and the outlet becoming the inlet when the direction for rotation is reversed.

High and Low Pressure Gas-Generators.—Pennink, J. M. K., of Haarlem, Holland. No. 12,131; June 22, 1895.

This invention relates to gas-generators, such as are described in patent No. 2594 of 1895. The improvements specified by the inventor are: (1) To arrange the generator so that the explosive mixture is produced within the rotary drums, instead of outside the apparatus; so as to prevent any explosion from taking place before the time when it is wanted. (2) To provide a device whereby liquid fuel may be employed for the production of the explosive mixture, and ignited. (3) To arrange the apparatus so that the heating of its parts is lessened, and the required quantity of the cooling fluid thereby reduced.

Gas Producing Lamps.—Thorp, T., of Whitefield, and Marsh, T. G., of Manchester. No. 12,355; June 26, 1895.

This invention relates to the production of gas in a chamber of the lamp by the chemical action of (say) water and calcic carbide; and it consists in constructing such lamps so as to make them automatic or self-regulating—that is, so that they may produce gas for consumption by the burner in proportion as it is consumed.

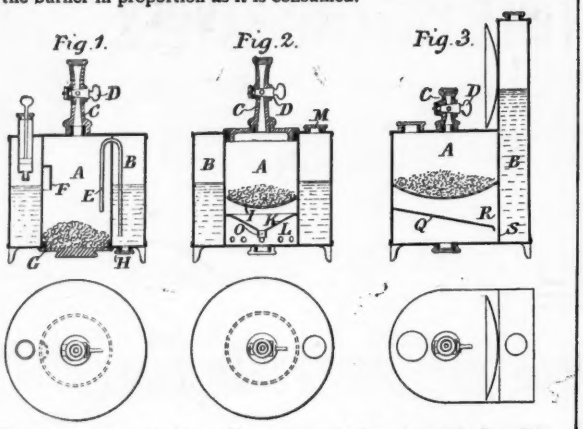


Fig. 1 represents one form of lamp in vertical section and plan. Figs. 2 and 3 are similar views of modified forms of the lamp.

The lamp contains two chambers A and B—the former in which the gas is evolved, and the latter in which the liquor used in the production of the gas is contained. The lamp is provided with a nozzle C, to which the burner is screwed; a cock D being interposed between the producer and the burner.

In fig. 1, a dip or inverted syphon pipe E leads from the producer A to the bottom of the reservoir B. In the producer, a small inverted receptacle F is fixed, closed at the top end and open at the bottom. In the bottom of the producer is a charging-hole, closed by a gas and liquid tight cover G; and in the bottom of the reservoir is another charging-hole, closed by a cover H. In order to charge the lamp and produce gas, the lamp is turned upside down, and the charging-holes are opened. Into the producer is charged the calcic carbide; and the small receptacle F is filled with the water. Upon turning the lamp over to bring it into its normal position, the liquid in F runs out; and, coming into contact with the carbide, causes it to evolve gas. If the passage to the burner be closed by the cock D, the gas will force the water back out of the dip-pipe, and pass down it—bubbling up into the space above the liquid in the reservoir B, where it will be confined and press upon the liquid contained therein. Upon opening the tap to the burner, the pressure of the confined gas in the reservoir will force the liquid up the dip-pipe, whence it will drip upon the solid charge, and cause the production of more gas. If the gas is produced more rapidly than it is consumed, the pressure in the producer will rise till it balances that in the reservoir; and the further flow of liquid into the producer will then be stopped till the pressure has decreased again. A further quantity of liquid will then again be forced upon the solid charge.

In fig. 2, the producer A and reservoir B are charged from the top. The producer is fitted with a perforated shelf or grid I, upon which the carbide is charged, and with a false bottom K, provided with a small central aperture O, through which, and holes L in the producer shell, the two chambers A and B communicate. The reservoir is filled with water through the hole M, so that the liquid does not reach the perforated plate. If filled so as nearly to touch the plate, by shaking the lamp, a little liquid may be brought into contact with the carbide, and the action be started; or a small air-compressing pump may be used for slightly compressing the air in the reservoir, and thereby force the liquid through the aperture O into contact with the carbide. The pressure of the gas generated in the producer while the cock D is closed, will force the liquid back through the aperture O and holes L, when the pressure of the gas becomes greater than that of the air contained in the reservoir, thereby stopping to a large extent the production of gas, as the aperture O is small, and little evaporation will take place.

The lamp shown in fig. 3 differs from fig. 2 only by its shape; the reservoir B being placed at the side of the producer, instead of surrounding it, and the conical false bottom K replaced by an inclined false bottom Q. The producer and reservoir communicate through openings R and S.

Production of Heating and Illuminating Gas.—Thorp, T., of Whitefield, and Marsh, T. G., of Manchester. No. 12,356; June 26, 1895.

This invention relates to apparatus for the production of acetylene gas from calcic carbide and water; but it is also applicable to cases where a solid is acted upon by, and reacts upon, a liquid (and *vice versâ*) in the production of gas.

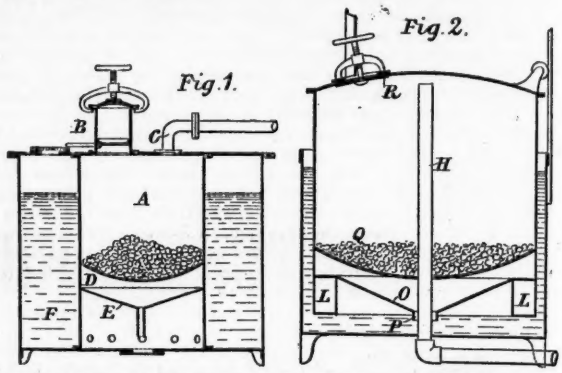


Fig. 1 shows a closed vessel A, fitted with a gas-tight hopper B at the top, and provided with a pipe C for leading off the gas to the holder. In the chamber is fitted a perforated shelf D, some distance from the bottom. The bottom E of the chamber is preferably concave, and provided with a small aperture or pipe. The chamber is set in a tank F of liquid; access for liquid into the interior of the chamber being had by the pipe attached to E. The liquid in the tank around the chamber may be open to atmospheric pressure in some cases; in others, it may be sealed to the atmosphere, and internal pressure created in the tank.

In fig. 2 a tank G is used, fitted with a central standpipe H, and manholes for removing the residue. There is a bell or holder in the tank, which is rendered buoyant by air-tight chambers L, or counterbalance weights may sustain it. To the bell a concave bottom O is fitted, having an aperture P therein; and at a suitable distance above the bottom is a perforated plate Q, to support the solid substance used for producing gas. There is a gas-tight charging-hole R to the bell, through which to feed the carbide.

In the production of gas, the tank is filled with the liquid to the desired extent; and a charge of carbide is fed on to the perforated grating through the charging-hole. In the apparatus represented by fig. 1, the gas production is started by compressing the air in the tank F above the liquid—by an air-compressor, if the tank is closed, or by filling in some additional liquid, if it is an open tank. In the apparatus shown in fig. 2, the gas production is started by lowering the bell till the solid charge comes in contact with the liquid. Gas is then evolved; and if not carried off as rapidly as produced, its pressure will, in the case of the fixed chamber, force the liquid through the aperture in the concave bottom into the tank, and, in the case of the moveable bell, lift it and raise the solid charge away from the liquid. The area of the aperture being small in comparison with the area of the grating and chamber, little or no vapour will be produced from the liquid; and consequently very little or no gas is made when the liquid is at, or near to, the level of the aperture, which would not be the case if the whole surface of the water were exposed to evaporation. When the pressure falls, the liquid will come into contact again with the carbide, by the pressure of the air above it in the tank F or its gravity, or by the descent of the bell; so that the production of gas will regulate itself in proportion to the consumption.

Gas-Heater for Railway Carriages.—Janse, B., and Witte, J. de, of Utrecht, Netherlands. No. 13,529; July 13, 1895.

This invention relates to apparatus for heating carriages by gas (especially railway and tramway carriages), by forming under the carriage floor a double metal casing. In the inner casing, which constitutes a heating chamber, there are arranged a number of atmospheric gas-burners and a number of sloping baffle-plates, upon which the flame and hot products of combustion play on their way to an ascending chimney-pipe. The outer casing forms an air chamber surrounding the heating chamber. Air admitted by orifices at its lower part becomes heated, and ascends through gratings in the floor into the body of the carriage, which receives heat also from the plate covering the heating chamber. A small kindling burner is fixed beside the main burner, so that at any time the apparatus can be brought into action; the cock being connected to the coupling of the carriage, or to the horse attachment, in such a manner as to be automatically closed when the carriage is not in use.

Manufacture of Illuminating Gas.—Willson, T. L., of New York. No. 13,750; July 18, 1895. (Date claimed for the patent, Dec. 19, 1894; being the date of the application in the United States.)

This invention relates to the manufacture of illuminating gas, and especially to enriching or increasing its illuminating power, by adding thereto in determined quantities acetylene gas, "under such conditions as that an economical and practical illuminating gas of increased brilliancy will be produced."

The specification (which is not illustrated) is as follows: "In carrying out my invention, I add to an illuminating gas containing hydrocarbon a determined percentage of acetylene, independently produced. I have discovered that, in order to accomplish a practical commercial

result, it is necessary that the acetylene be added to a gas—whether water gas or coal gas—which contains an illuminant in the nature of a hydrocarbon, distinct from the body of the gas itself. In other words, if acetylene is added to water gas (consisting generally of hydrogen, carbon monoxide, and carbon dioxide), the added illuminant after a short time decreases or practically disappears; whereas if the gas is illuminating gas having a free hydrocarbon, the illuminating effect of the acetylene continues, and remains practically permanent. No precise or unvarying proportions can be laid down for the carrying out of my invention; it being only essential that there shall be added to an illuminating gas which is deficient in illuminating power, a sufficient proportion of acetylene gas to increase its luminosity to the candle power required. Taking a coal gas of such quality that, when burned in an ordinary 3-foot burner, it gives 9-candle power, I enrich it by adding to ten volumes thereof one volume of acetylene gas; and I thereby increase its illuminating power so that the same burner, instead of giving a 9-candle power light, affords an illumination of 25-candle power. Or I take a water gas which has been already enriched by any of the known methods, and having (for example) 18-candle power when burned in a standard 5-foot burner; and I enrich this gas by adding 10 per cent. by volume of acetylene gas, whereby I increase its luminosity to 40-candle power. To make my process available with water gas, it is practically necessary that the gas shall have already been enriched to some extent by the addition of hydrocarbons, as it is found, by adding acetylene to simple water gas (hydrogen and carbon monoxide), much of the illuminating effect of the acetylene is lost."

Production of Illuminating Gas.—Willson, T. L., of New York. No. 13,766; July 18, 1895. (Date claimed for the patent, Dec. 19, 1894; being the date of the application in the United States.)

The patentee claims to have discovered that if acetylene is added to a non-luminous water gas in its ordinary condition, the illuminating power of the acetylene after a short time is practically lost. If, however, there be added to such gas the gaseous products obtained from heating acetylene, the illuminating power remains. He therefore proposes to add such decomposition products, either by primarily heating the acetylene, and adding the gaseous products in determined percentage to the gas; or to add the acetylene, and pass the combustible gas carrying the acetylene through a fixing retort or heated tubes. These should, he says, be approximately of a red to a bright-red heat; and he adds from 10 to 25 per cent. of the volume of the combustible gas in such decomposed products of acetylene. The result of this action is to prevent a decomposition of the acetylene, which would occur if the acetylene were added to the water gas without either prior or subsequent heating. The inventor says he is not aware what the chemical action is. But it is probable that a new carbon compound is formed under these conditions; and it is the formation of such compound, and the consequent destruction or reduction of the illuminating power, that he is desirous of avoiding. In concluding his specification, the patentee says he "may add the products of decomposition of acetylene as well to coal gas or enriched water gas; but the especial advantages of the process are to be derived from the addition of such products of decomposition to a practically non-luminous gas."

Preventing the Fraudulent Operation of Coin-Freed Gas-Meters.—Glover, R. T. & J. G., of St. John Street, Clerkenwell. No. 14,197; July 25, 1895.

This means for preventing persons fraudulently operating coin-freed apparatus, consists in the use of a shutter for closing the coin-slot, and the combination with the shutter of a pawl, for engaging the notches or teeth of the coin-actuated mechanism so as to prevent the movement of the mechanism while the coin-slot is open.

Fig. 1.

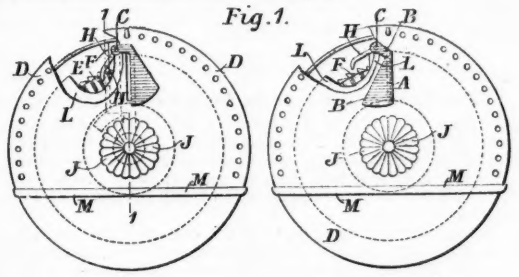


Fig. 2.

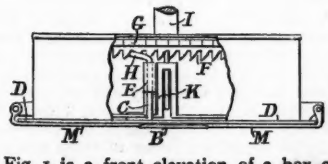


Fig 3.

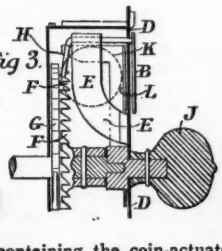


Fig. 1 is a front elevation of a box containing the coin-actuated mechanism—a portion being broken away, to show the position of the check-pawl or detent when the coin-slot is open; also a view showing the position of the check-pawl when the coin-slot is closed. Fig. 2 is a plan of the coin-mechanism box, with the internal parts in the position occupied when the coin-slot is open. Fig. 3 is a part sectional elevation on the line 1 of fig. 1.

In cases where a coin inserted acts as the block to rotate a notched wheel when a handle or lever is turned by an intending purchaser, the coin-slot A would be covered with a shutter B, and the shutter be fixed to a spindle C, passing through the front plate or cover D of the coin-mechanism box, and through a bearing pillar E; and is then bent down to enter the notches F of the wheel G, so as to act as a pawl H to resist the forward movement of the wheel, unless the shutter be first moved over to close the coin-slot; or a pawl may be fixed upon the end of the spindle C, instead of bending the spindle to act as a pawl.

The coin-slot must be covered by the shutter before the pawl is moved out of the notches. Therefore it follows that the wheel G, which is fixed to the spindle I, that operates the internal mechanism of a coin-freed apparatus (say, for instance, a gas-meter) cannot by any appliance be rotated from outside the coin-slot, except by legitimately turning the handle J after the insertion of a coin of given size, which (by resting in the pocket K, and in one of the notches F of the wheel G) is the means by which the wheel is turned when the handle is rotated. When the shutter B is moved over to open the coin-slot for the insertion of a fresh coin, it automatically locks the wheel G, by causing the pawl H to enter one of the notches F, as described.

A rotating shutter L, affixed to the coin-pocket, closes the coin-slot A on the inside, and is provided for the purpose of preventing the insertion of a coin, which can only be done when the handle is turned to bring the slot of the coin-pocket opposite the slot A. M is a locking-bar.

Valves for Gas-Engines.—Southall, J., of Worcester. No. 18,995; Oct. 10, 1895.

The supply and exhaust valves for gas-engines, according to this invention, are situated in the back cover of the cylinder; their centres being on the same horizontal line. Behind their stems, a horizontal spindle (carried in suitable bearings) is revolved at half the speed of the crank-shaft—preferably by chain gearing driven from the crank-shaft. On this spindle is a casting working on a sliding key, so that it revolves with the spindle, but can, when desired, be caused to move laterally against a light spring. On the face of the casting three cams are formed, two of which serve to operate the supply and exhaust valves, and the third to perform the governing, for which purpose both its edge and one side are used as cams.

The governor (driven by a wheel mounted on the spindle), when the engine exceeds its proper speed, draws back a spring-pawl, so as to allow a bar to drop down between a stop on the back of the cylinder cover and the inner end of a short lever, which is so pivoted that, during the normal working of the engine, it moves backwards and forwards. Its other end, urged by a weaker spring than the one on the spindle, presses lightly against, and follows the cam face on the side of the third cam. This lever, when it meets the dropped governor-bar, is prevented from moving; and therefore it drives the cam casting laterally along the shaft, and brings a different outline of the exhaust cam opposite the exhaust-valve. This keeps that valve open during the next charging and compressing strokes, and moves at the same time the supply cam clear of the supply-valve stem. The edge of the third cam also now comes into action, depressing a second small lever, so as to lift the governor-rod up into its original position. If the speed of the engine has been sufficiently reduced, the spring pawl then again engages with it, holding it up and allowing the cam casting to return (by the aid of the spring) laterally along the spindle to its original position, and perform its normal operations. If a controlled ignition is used, a further cam can be fixed on the spindle in order to operate the ignition-valve.

Glowing Nets for Gas-Lights.—Burkert, H., and Seemann, R., of Berlin. No. 3262; Feb. 13, 1896.

The material of which these "glowing nets" is composed, consists of a mixture of thorium with elements of the chrome group (preferably with uranium), without any use of magnesia, zirconium, and elements of the cerium group.

The specification (which is not illustrated) is practically in these words: The improvement which is the subject of this invention consists in the employment of a mixture of thorium and elements of the chrome group—preferably of thorium and uranium—as materials for the "glowing nets" of gas-lights. The proportion of the elements is chosen so that the oxide of thorium obtained by burning afterwards, diminishing the lighting power, becomes neutralized by the influence of oxides of the chrome group—especially by oxide of uranium. The proportion is not always alike, because the nitrate of thorium, which is to be employed (instead of the element thorium itself) as raw material, is not to be had pure. The proportion, therefore, must always be ascertained according to the quality of the nitrate of thorium employed. However, the deviation in the proportion will remain within moderate limits, so that 1 per cent. of oxide of uranium will always give the oxide of thorium its strongest power of emission. As known, till now the "glowing nets" have been made of magnesia, in mixture with zirconium, or with the so-called rare earths—*i.e.*, with metal-earths of the cerium group (scandium, yttrium, lanthanum, didymium, ytterbium, erbium, &c.); and lately also thorium, which does not belong to the cerium group, has been sometimes employed in the mixture. The inventors of the present improvement claim to have ascertained, in making numerous experiments, that not only the so-called rare earths (of the cerium group) are of the nature to increase the lighting power of the gas-flame of a bunsen burner, when mixed with magnesia and with or without a little thorium, but that the same effect will be obtained by the mixing of metals of the chrome group, especially of uranium with thorium, without employing any magnesia, zirconium, or elements of the cerium group. The inventors came upon this improvement while experimenting with several oxides of thorium, giving cause to doubt the elementary danger of this metal-earth, and teaching that "some not yet discovered accompanying element is of the nature to be neutralized by an element of the chrome group, preferably by uranium." The results of the experiments led to the fact that elements of the cerium group, as well as magnesia, are superfluous for the making of "glowing nets," and that the light power, as already remarked, is "profitably favoured by nets of thorium-uranium or thorium-chrome and the like, in spite of the effect of the magnesia and zircon nets presently in use."

Generating Acetylene.—Clark, W. C., of New York; No. 7242; April 2, 1896.

This is a slight modification of the arrangement of apparatus

described in the same inventor's earlier published patent—No. 7243 of 1896 (see *ante*, p. 1340). The main alteration consists in placing the cylindrical generating chambers B B^1 at each side of the supply holder A, instead of both at one side, and providing separate water-tanks above each generator, with independent cocks to regulate the supply—actuated by arms fixed at opposite sides of the holder, and not (as in the other patent) both at one side, and operated at different times according to the rise of the supply holder.

APPLICATIONS FOR LETTERS PATENT.

12,874.—Denayrouze, L., "Incandescence gas-burners." June 11.
12,900.—Earl, S., "Manufacture of acetylene gas." June 11.
12,924.—Boult, A. J., "Regenerative gas-burners." A communication from A. Wunderlich. June 11.
12,942.—Thorp, T., and Marsh, T. G., "Treating acetylene prior to combustion. June 12.
12,943.—Rowbotham, W., "Gas-generating apparatus for explosion engines." June 12.
13,012.—Atchison, R., "Incandescent gas-lamps." June 12.
13,060.—Macdonald, A., and Paterson, A., "Burners for incandescent gas-lights." June 13.
13,115.—Choquette, C. P., and Morin, A. M., "Acetylene generators." June 13.
13,147.—Atkinson, J. E., and Labouchere, J. M., "Automatic apparatus for the manufacture of acetylene gas." June 15.
13,204.—Cripps, F. S., "Fittings for incandescent gas-lamps." June 16.
13,218.—Cripps, F. S., "Fittings for incandescent gas-lamps." June 16.
13,240.—Boult, A. J., "Gas stoves or heaters." A communication from A. Wunderlich. June 16.
13,255.—Voelker, W. L., "Hoods or mantles for incandescent gas-lights." June 16.
13,256.—Voelker, W. L., "Hoods, mantles, or gratings for incandescent gas-lights." June 16.
13,296.—Thompson, W. P., "Burners for incandescent gas lighting." A communication from Messrs. Niehusen and Zerning. June 16.
13,309.—Miller, P. S., "Gas regulators and burners." June 17.
13,331.—Lawson, W., and Prescott, T., "Cylinders for storing gas or gaseous fluids under pressure." June 17.
13,385.—Thompson, W. P., "Burners for acetylene gas." A communication from Messrs. Briquet and Co. June 17.
13,398.—Guépin, H., "Acetylene gas-lamps." June 17.
13,421.—Harrison, S., Dickinson, G. W., and Sheard, J. T., "Prepayment gas-meters." June 18.
13,511.—Bowers, A. F., "Regulators and gasholders for acetylene gas." June 18.
13,548.—Crossley, F. W., and Atkinson, J., "Internal combustion motors." June 19.
13,557.—Haviland, F. H., Holloway, A., and Collier, J. B., "Generating, purifying, storing, and supplying acetylene gas at a uniform pressure." June 19.
13,606.—Falk, S., "Incandescent gas-burners." A communication from the Städtische Gas und Wasserwerke. June 19.
13,648.—Musso, J., "Portable and hygienic incandescent lighting, wherein the evaporation of hydrocarbons is produced under pressure." June 20.
13,653.—Fenwick, J. B., "Gasholders or the like." June 20.
13,658.—Martini, A., "Gas-burners for incandescent lighting." June 20.
13,659.—Duke, J. F., "Mantles or incandescing bodies for incandescent gas-lamps." June 20.

Gas Profits at Stoke.—The Gas Committee of the Stoke Town Council have just remitted to that body £1000 on account of the current year's profits. This is the second £1000 handed over since April 1 last.

The Recovery of Cyanide at the Huddersfield Gas-Works.—Subject to satisfactory conditions being entered into, new plant for the recovery of cyanogen is about to be tried at the Huddersfield Corporation Gas-Works. The patentees have offered to put down the plant at their own cost.

The Projected Water Reservoirs of the Wakefield Corporation.—The Water Committee of the Wakefield Corporation have decided, subject to confirmation, to postpone the construction of the three remaining reservoirs on Rishworth Moors, provided for in their parliamentary powers, for a period of ten years. A Sub-Committee have reported that such works are at present unnecessary.

A Burial Ground and the Leeds Water Supply.—Last Thursday, Dr. Hoffman, of the Home Office Department, held an inquiry at Fewston for the purpose of reporting to the Secretary of State as to the desirability of closing the Fewston Burial Ground. Alderman Alfred Cooke (the Chairman of the Leeds Corporation Water Committee) informed the Inspector that the population of the borough, together with that of the outlying districts which the Corporation supplied with water from the Washburn Valley, was some 500,000 people; and that undoubtedly the churchyard, which was only some 200 yards from the Swinsty reservoir, was already more than full, as agreed by the West Riding and Wharfedale authorities. On that ground alone, they wished for an order compelling the immediate closing of the present churchyard. The Vicar, however, said that the burials, on an average, were only some thirteen a year; and that, in his opinion, there was room still left for interments for nine years to come. The Inspector intimated that he should certainly advise the Secretary of State to issue an order for the closing of the ground at once. With regard to the extension of the churchyard, Alderman Cooke objected to several sites on account of their close proximity to the reservoir; and he suggested one some 600 yards away from Swinsty, as most suitable for the purpose, not only in point of distance, but that the strata fell away from, instead of towards, the reservoir. Dr. Hoffman promised that his report should be issued in a few days.

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

The Estimation of Nitrogen in Coal Gas.

Sir,—I regret that absence on holiday has caused delay in my responding to Mr. Wright's letter on the above subject (*ante*, p. 1271).

I gather from Mr. Wright's remarks that, although he is disposed to believe that the amount of nitrogen in coal gas can be accurately determined, he does not share my opinion that "it is doubtful whether in coal gas any but traces of nitrogen are derived from the coal itself:" (1) Because in the light of various published analyses showing the presence of exceptionally large amounts of nitrogen, such an opinion would place the gas industry of this country in an equivocal position. (2) That the adoption of my view would render necessary further investigations into the distribution of the nitrogen of the coal among the distillation products.

With regard to the first objection, Mr. Wright appears to have overlooked the fact that, were the whole of the 35·7 per cent. of the nitrogen of the coal used (Foster's highest figure for nitrogen not accounted for in the coke and ammonia) present in the gas in the free state, it would represent no more than 1·8 per cent.; and that if this percentage were deducted from that given in the analyses quoted, they would remain but little less startling. Again were the administration of the undertaking in whose town supply Professor Foster found 14·46 per cent. of nitrogen and oxygen, informed that, instead of making 10,000 cubic feet of gas per ton from their coal, they made only 8700 cubic feet, it appears to me that their equanimity would be but little less disturbed if, in the place of the latter figure, 8500 cubic feet were substituted.

With regard to Mr. Wright's second objection, I would ask if this field of research can be considered as covered by the investigations mentioned; for it would seem by no means improbable that not only is the distribution of nitrogen among the distillation products liable to variations with every coal used, but that a different disposal may be expected at every temperature to which a coal may be subjected. I must point out also that the experiments of Professor Foster and Mr. Wright, in which *iron* tubes and retorts were respectively used, cannot be regarded as conclusive evidence against my opinion; for this material appears to have considerable influence upon the distribution of nitrogen among the products. So far as ammonia and cyanogen are concerned, I have found serious discrepancies.

In concluding, Mr. Wright asks how it can be practicable to dilute coal gas with air to the extent indicated in the analyses which he quotes. There, again, as I have pointed out before, my opinion as to the distribution of the nitrogen of the coal is not seriously involved, but rather the belief that the nitrogen in coal gas can be accurately estimated. To mix coal gas pure and simple with such an amount of air as is represented by some of the analyses, would certainly be a ruinous method of procedure for any gas undertaking. But it must not be forgotten that such air would get into the gas at the retort-house, and that it would consequently be partly saturated with hydrocarbon vapours at the expense of the tar. Moreover, the most deleterious element, so far as illumination is concerned—the oxygen—would be considerably reduced by ferrous sulphide, or entirely removed by calcium sulphides, in the purifiers. I am certainly of opinion that its admittance would be uneconomical, and should be strenuously avoided. Efforts in this direction will be found to be materially assisted by daily estimations of the oxygen in the gas at the outlet of retort-houses.

I thank Mr. Wright for his expression of opinion that my views have been arrived at after a careful study of the subject. Such indeed has been my endeavour.

E. Llewellyn Pryce.

Adderley Street Gas-Works, Birmingham,
June 23, 1896.

The Value of the Sunlight Incandescent Mantles.

Sir,—With reference to the letter of Mr. G. Oppenheimer, the General Manager of the New Incandescent (Sunlight Patent) Gas Lighting Company, Limited, which appears in your issue of the 23rd inst., I would point out that there is not one single line in that letter which refutes one word of the criticism offered by me upon Professor Vivian Lewes's paper.

Mr. Oppenheimer admits that, at the end of April last, Professor Lewes had Sunlight mantles sent to him to test. One hundred hours is the extreme limit of time required to prove the duration of the burning life of a Sunlight mantle; and my contention was that Professor Lewes had the opportunity of making a test demanding such a comparatively short amount of time.

Mr. Oppenheimer foreshadows the introduction of some new mantle, and assumes a feeling of annoyance on my part in connection with this new mantle. He states that Professor Lewes's remarks were based on the result of his experiments with this new mantle; and I can only, therefore, presume that this is something which has not yet been supplied to the public. I can assure Mr. Oppenheimer that the introduction of a new mantle by the Sunlight Company will not cause me the very slightest degree of annoyance. On the contrary, I await its advent, not only with complacency, but with a pleasurable expectation. If Mr. Oppenheimer will kindly let me have a dozen of these new and remarkable mantles, as soon as he can conveniently do so, it would enable me to take those steps which may be necessary without further delay. I have every confidence that Mr. Oppenheimer will comply with this not unreasonable request.

I am sorry that Mr. Oppenheimer should have experienced any astonishment at our "audacity" in continuing to talk of 1000 hours as the life of our mantle. Mr. Oppenheimer states that it is notorious in the trade that the real life of our mantles is exceedingly short. Doubtless, this misapprehension is due to the paucity of dealings which Mr. Oppenheimer has had with the trade. But, at any rate, the technical journals are open to him; and we would draw his attention to a paper read at the end of April by Mr. E. C. Riley, of Swindon, before the South-West of England District Association of

Gas Managers (see *ante* p. 1215). In that paper, Mr. Riley alludes to the Welsbach Incandescent Gas-Light Company's burners installed in railway-yards and engine-rooms; and even when subjected to the severe conditions of use in such places, he found that the average life of the mantles was 800 hours. He further stated that he had known them to last for over 2500 hours, at the end of which time they still gave a light which would compete with the ordinary gas-light. Perhaps Mr. Oppenheimer would also refer to the paper recently read before The Gas Institute by Mr. Dexter, of the Winchester Gas Company, in which he gave his experience of the duration of mantles for street-lighting. Having read these, perhaps Mr. Oppenheimer will think that, however "audacious" we may be in some matters and when questioning the commercial value of the Sunlight mantle, at any rate we are not guilty of audacity, but on the contrary are somewhat modest, in claiming 800 to 1000 hours as the average life of the Welsbach mantles.

We do not at present contest the right of the Sunlight Company to manufacture the mantle composed of alumina and chrome; but the exhaustive experiments we have made in this direction convince us that it is impossible that this combination could produce a mantle giving 15 candles per cubic foot of gas at a normal pressure. The results obtained by Professor Lewes clearly indicate either that the mantle contained substances which the Sunlight Company have no legal right to employ, or that the alleged lighting power obtained has no practical duration.

JULIUS MOELLER, General Manager,
Incandescent Gas-Light Company, Limited.

Palmer Street, Westminster, S.W., June 25, 1896.

Crossley Gas-Engines.

SIR,—The point of Mr. D. H. Irwin's correction, in your issue of the 23rd inst., so far as I am concerned, appears to resolve itself into the difference between "two" and "several." No mention being made of the fact that Messrs. Crossley, as well as Messrs. Tangye, had put down an installation for the Wear Commissioners might possibly be an *omission*, but can hardly be construed into an "extraordinary inaccuracy." The fact that such installations have been put down by *two* firms, and presumably giving satisfactory results in either case, is additional testimony in favour of gas motors in a field hitherto unrecognized.

J. HOLLIDAY.

Scarborough, June 24, 1896.

Number of Gas-Engines in Different Towns.

SIR,—I am collecting, for my book on "Gas-Engines," some statistics as to the number of gas-engines in different towns. Would you allow me, through the medium of the "JOURNAL," to ask the chief engineers and managers, and others, if they would kindly send me direct the approximate number in use up to (say) the end of last year or beginning of this? and I shall be much obliged. Also the approximate horse power of the largest in use.

BRYAN DONKIN.

Southwark Park Road, Bermondsey, S.E., June 26, 1896.

Ince (Lancs.) Water-Works.—The members of the Ince District Council made an official inspection of their water-works at Golborne on the 15th inst., and Mr. R. Winstanley, the Consulting Engineer, acting as guide to the party, fully explained the scheme. It was in the year 1871 that the Ince Water Act was passed. The population of the township was then about 12,000. Arrangements were made with the owner of the Lightshaw Estate at Golborne to sink and bore for water in the red sandstone rock in that estate. The works were opened in May, 1872; and they now supply a population of 28,000—the quantity of water sent out being about 350,000 gallons per day. In recent years, the supply to Ince has been supplemented by taking water from the Rivington reservoirs of the Liverpool Corporation; there being an agreement for this between the two authorities. At the Golborne works there are two shafts or wells, 9 and 10 feet in diameter respectively, and sunk in the red rock to a depth of 150 feet. At the bottom of these a number of tunnels are driven for the purpose of collecting the water and making storage space for it. A vertical pumping-engine, with a 48-inch cylinder working a balance-beam, air-pumps, and condenser, is in use, as well as forcing engines to get the necessary pressure for supplying the higher parts of the town.

The Water Supply of Stratton and Bude.—The question of the water supply of Stratton and Bude continues to occupy a good deal of attention without making much progress towards settlement. Several months ago, the District Council gave conditional approval to a scheme prepared by Mr. Anson for bringing in water from Wrasford Moor at an estimated cost of £7000; and the scheme was apparently in a fair way towards realization when difficulties were raised on account of the cost, and an alternative proposal was put forward. An effort was made to induce the Local Government Board to sanction a loan for the less costly scheme; but it was unsuccessful. In the meantime, the drought has increased the sense of local need, and the Parish Councils have been urging the District Council to deal with the subject at once; while the District Council have been seeking means for postponing part of the expense. The latest suggestions were that something less than the full quantity of water yielded by the proposed gathering-ground should be arranged for, and that the construction of a reservoir should be postponed. At a recent meeting of the Council, a report was submitted by Mr. Anson. The necessity of acquiring the full area of the gathering-ground was insisted upon; but the opinion was expressed that an impounding reservoir is unnecessary for the present. In the course of the discussion several members expressed the opinion that the yield of water from Wrasford Moor was inadequate, and that, under the circumstances, the Local Government Board ought not to insist upon the adoption of the scheme. It was decided to obtain the opinion of another engineer before the scheme is proceeded with; the Chairman (Mr. J. King) who suggested this, expressing the opinion that it would be no reflection upon the ability of Mr. Anson, and would afford satisfaction to all concerned.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Bills last week:—

Bills read the first time and referred to the Examiners: Burton-upon-Trent Corporation Bill, Dalmeny and Kirkliston Water Provisional Order Bill, Gas and Water Provisional Orders Bill, Kelty Water Provisional Order Bill.

Bills read a second time: Gas and Water Provisional Orders Bill, Yeovil Corporation Water Bill.

Bills read a second time and committed: Edinburgh Extension Bill, Gas Provisional Orders Bill, Portsmouth Borough Water Bill, Water Provisional Orders Bill.

Bills reported: Gas Provisional Orders Bill, Huddersfield Water Bill, Lanarkshire (Middle Ward District) Water Bill.

Bills reported with amendments: Brighton Corporation Water Bill, Chelsea Water Bill, Eastbourne Water Bill, Kirkcaldy and Dysart Water Bill, Leamington Corporation Bill, Matlock Bath Gas Bill, Portsmouth Borough Water Bill.

Bills read the third time and passed: Bexhill Water and Gas Bill, Chelsea Water Bill, Culter Water Order Confirmation Bill, Dublin Corporation Bill, Lambeth Water Bill, Matlock Bath Gas Bill.

The Bournemouth Gas and Water Bill was referred to a Select Committee, consisting of Lord Northington (Chairman), Earl Bathurst, the Earl of Yarborough, Lord Douglas, and Lord Pirbright.

HOUSE OF COMMONS.

Monday, June 22.

DEFECTIVE GAS-METERS.

Mr. LOUGH asked the President of the Board of Trade whether his attention had been drawn to the defective condition of meters supplied by The Gaslight and Coke Company throughout that part of London which was north of the Thames; whether he had observed, from cases which had been brought before the Magistrates, and ventilated in the public Press, that these meters usually erred in favour of the Company—registering a much larger quantity of gas than had been consumed, and that the Magistrates were practically powerless to give adequate relief, even when a case was proved; and whether, under these circumstances, he could use his powers to compel the Company to supply their customers with meters of a less defective character.

Mr. RITCHIE: Except from the hon. member, I have not had complaints on the subject referred to in the question, I have seen newspaper statements of the kind described; but I cannot express any opinion as to whether or not they are well founded. I have no power to compel the Gas Companies to supply their customers with meters of any particular description. But, under the Sale of Gas Act, provision is made for testing meters; and that duty is imposed on inspectors appointed by the local authorities—in this case, the London County Council.

The following progress was made with Bills last week:—

Bills read the first time, and referred to the Examiners: Culter Water Order Confirmation Bill, Dublin Corporation Bill.

Bills reported: Bilston Improvement Bill, Dalmeny and Kirkliston Water Provisional Order Bill, Kilmarnock Corporation Water Bill.

Bills read the third time and passed: Burton-upon-Trent Corporation Bill, Cowes Gas Bill, Dalmeny and Kirkliston Water Provisional Order Bill, Falkirk and District Water Bill, Gas and Water Provisional Orders Bill, Kilty Water Provisional Order Bill, Local Government Provisional Orders (Gas) Bill, Manchester Corporation Bill.

HOUSE OF COMMONS COMMITTEE ON THE LONDON WATER BILLS.

Friday, June 12.

(*Before Sir* J. PEASE, *Chairman; Sir* J. BRUNNER, *Mr.* BALDWIN, *Mr.* BOND, *Mr.* J. STUART, *Mr.* BRIGG, *Mr.* FRY, *Mr.* LEES KNOWLES, *and Mr.* MUNTZ.)

THE STAINES RESERVOIRS BILL.

On the resumption of the proceedings this morning,

Mr. *A. R. Binnie*, Engineer to the London County Council, in further examination, stated that the Royal Commission had said very distinctly that no power of the kind sought in the Bill should be granted either in the Lea Valley or the Thames Valley, without restrictions being put upon the draught of water. They also made it clear that the water, as it came down to the intakes, was not in a suitable condition for delivery, unless it was subjected to certain important processes. About these processes the Bill was silent. There were no filter-beds provided for; and no consideration had been given as to how probably 50 or 60 million gallons a day were to be filtered. The report of the Royal Commission said that regulations as to the area of the filter-beds, the depth of sand, the frequency of renewal, and so forth, as well as the number of days' storage which should be taken into the reservoirs, should be drawn up after competent inquiry, and adherence to such regulations should be strictly enforced. In his opinion, provisions of this kind should be contained in the Bill. If the Companies were to take this water at all, there ought to go, side by side with the power to abstract it, proper provision for filtration. He pointed out that the population above the intakes of the Companies in the Thames Valley was about 1,080,000, according to the census of 1891. This included the whole valley from Lechlade. Assuming that this population were efficiently supplied with a proper water supply at

the rate of 30 gallons a head per day, it would mean an average discharge of clarified effluent of 30 million gallons per day. The dry-weather flow of the river was about 400 million gallons; so that if the Thames Conservators clarified all the sewage in the most approved way, the total volume of the river would contain 7 per cent. of the effluent. He differed from the statement of the promoters that there was necessity for further storage or for further water. He also disagreed with the engineering details of the Bill. And there was another disagreement—namely, that should the Committee think that in the future it was necessary to grant any such powers as these, the Companies should be brought under some intersale clause. The reservoirs should not be made exclusively for one, two, or three Companies; otherwise very grave difficulties would arise on purely public grounds, not affecting the County Council or anything else.

Cross-examined by Mr. PEMBER, witness admitted that if the learned gentleman were to occupy himself in cross-examination for a year, it would not alter his (witness's) views on the Bill. He considered that the water supply per head of the population of London should be 35 gallons a day. Forty or fifty years hence, however, he would allow 40 gallons. With regard to waste, he did not think that, by any system of waste prevention, they could alter very much the habits of the population. Looking at the results obtained by Mr. Collins, the Engineer to the New River Company, as the consumption in their district had been brought below 35 gallons a head per day, they must regard this work as very satisfactory. He was aware that there were agreements between the Water Companies and the Thames Conservancy Board, to the effect that water should not be sold from one Company to another without the consent of the Board. He agreed that what should be provided for was not merely the daily average consumption, but the maximum consumption. Taking the figures from the Companies, the average daily supply for the highest month in the year—July—was as follows: West Middlesex Company, 121,400,000 gallons per head; daily average in the highest week, 22,760,000 gallons. New River, 39,800,000 gallons; daily average in the highest week, 45,482,000 gallons. Grand Junction, 20,208,000 gallons; but in this case he could not give the daily average in the highest week.

Mr. PEMBER: Is not the method of storage—apart from such questions as the sewage farm—proposed by this Bill in principle far less objectionable than anything which could be done by the Companies in connection with their statutory powers of intake at present existing?

Witness at first replied in the negative; but being pressed on the point, and several questions having been put as to the condition of the river at certain periods, and the existing powers of the Companies to take water at any time, he said: Supposing it is decided that the future water supply of London is to be provided from the Thames, I think the Staines scheme is a better mode of effecting that object than the present system of supply. Until the new Water Trust can decide on the question of the future supply of London, I do not think the Companies want new storage powers.

But we have not got the Water Trust yet?—No; but the Bill is pending.

Yes, and your Water Bills have been "pending" for some years. How far has the Water Trust Bill got already?—It is in the House of Lords.

Which means that it has to come to the House of Commons; and here we are at the 12th of June.

Mr. J. STUART: But if the Bill is not passed, the County Council still possess the power of proceeding.

Mr. PEMBER: And who knows that the County Council will be more fortunate in years to come?

The CHAIRMAN: We are all equally wise on this matter.

Mr. PEMBER (to witness): You would not like to see London run the risk of starving for water within the next ten or fifteen years, would you?

Witness: Certainly not; and there is no reason to fear it will.

You know what the Royal Commission said should be done—that there should be a storage for twenty days, as recommended by General Scott. How many days' storage have the Grand Junction Company got?—About six days, I think. As I have said, if the Committee had decided that in the future London is to be provided with water from the Thames Valley, this would be a good scheme; but in view of the instruction given to the Committee by the House of Commons, I think it is a bad and extravagant scheme.

What would you like the Companies to do?—I do not think the Grand Junction Company have any necessity for new storage. They are pumping 5¼ million gallons of water per day more than is necessary to supply their needs. They have not nearly exhausted their power of taking water from the river.

What do you say about the West Middlesex Company?—They have about 20 days' storage. They get their water for this purpose at Hampton.

How many days would it take to fill their reservoir?—I have not gone into that; but, as to quantity, in 1894 they stated that their supply was one which would last until 1904.

Do you know that it would take 100 days to fill the reservoir?—I do not.

Is your general case that there is no need for any one of these Companies to have any storage at all during the period which must necessarily elapse before any Welsh water scheme could come into operation?—I do not go as far as that. I do not think they need any large storage reservoirs at Staines. They do not require more water power, at any rate, for the immediate future. It may be necessary for them to carry out small storage works in the future.

What do you call "the future"?—The next ten years.

That is the minimum period you would put on the completion of the works for a Welsh supply?—Yes.

But would not you be sorry to pledge your professional reputation that, if you set to work to-day, you could in ten years get your water from Wales?—If you had the Act, and gave the engineer next day orders to go on, I believe you would be able to do the work in that time.

The CHAIRMAN: I do not think you need labour that. If you got your Bill in 1897, you could get possession of the land in the autumn of 1898; and ten years from that date, according to Mr. Binnie, you might commence your supply.

Mr. PEMBER: Supposing we are right in this matter (and you must remember that we are supported by the Local Government Board), what would become of the health of London?

Witness: I answer that by saying that you could draw more water from the Thames.

Sir J. BRUNNER: What, in your opinion, ought we to do in the next two years—not in the next ten years?

Witness: If I may answer that in a broad way, I would say that I have to face a difficulty (and I imagine you have to face it too), which is that, looking at the Thames, you have the fact that in July, 1895, the statutory draught from the river was exceeded—the Companies taking from it 130·8 million gallons a day. The effect of this was that 331·2 million gallons per day flowed over Teddington Weir down the river. But it would not do for me or the Committee to take these figures as a guarantee of what would occur in the future, because the month of July, 1895, did not happen to be a dry one. I would look back, therefore, to the driest month, which I find was September, 1893, when the flow over Teddington Weir was 188·8 million gallons a day; the water taken by the Companies in that month being 109·5 million gallons a day. We find that, if we assume that the heaviest draught on record—130 million gallons—was taken from the river in what I may call the driest month, you have left in the river, flowing over Teddington Weir, 167·5 million gallons. These are the facts of the case. To provide for emergencies in the next two years, or the next five years, the Committee might, if they thought proper, make a temporary arrangement—they might allow the Companies to draw 140 million gallons a day from the river. The result of this would be that the minimum flow would be reduced by 10 million gallons a day over Teddington Weir—to a total flow of 158 million gallons. This is not the lowest amount that has been recorded. The lowest flow recorded was on Sept. 18, 1893, when it fell to 148·5 million gallons. What would be the effect on the river on an average of dry periods? Take from July to September, 1895, and the four months from July to October, 1887, as given in the tables presented yesterday. The flow, assuming the maximum flow to continue during the whole period, would be at the rate of 253 million gallons a day. Taking the six months from June to November, 1895, the average flow over Teddington Weir would be 273 million gallons. Then, to keep up the average of shorter periods than a month, I think the existing storage is sufficient. Of course, were the Committee granting such powers as those I suggest, it would be necessary for them to provide proper safegusrds. These powers would only be for a temporary purpose.

The CHAIRMAN: That would give you a supply without storage?

Witness: Yes; and what I am proposing is what the Royal Commissioners themselves thought. For the ordinary average consumption there is enough water. The arrangement I propose would go further than two years.

Mr. STUART: Do you consider that the amount which would be left to flow over Teddington Weir would be enough to meet the wants of the navigation in the lower river?

Witness: Yes; if the plan were applied temporarily, for it would not bring the minimum flow of the river down to what is proposed in this Bill. I understood from Mr. Hunter that, so far as the Grand Junction Company were concerned, if the Company could get the water, they would not want these works.

Mr. PEMBER: I do not think Mr. Hunter went so far as that.

Mr. Hunter expressed dissent from the witness's statement.

Mr. PEMBER: Your 10 million gallons are spread over the whole eight Companies?

Witness: Yes; I am dealing with the Thames as a whole, of course.

In re-examination, witness said that if the Bill before the House of Lords for the establishment of a Water Trust did not pass, the London County Council could bring in another Bill in 1897, or even in 1898; and the plan he proposed would allow a safe margin for legislation of this kind. After that, it would be necessary to come to some decision as to what was to be done for the supply of London with water in the future—whether the Welsh scheme was to be adopted, or whether London was to look for its water from the Thames. If, after that, the Welsh scheme were looked on as a good one, ten years would bring the water in. On the other hand, assuming that the Thames was the source of supply decided on for the future, there would be ample time to provide for as large an instalment of the scheme as the present Bill would effect.

The CHAIRMAN: I understood you, in one part of your evidence, to speak of the priority which this Bill would give the parties to it over the other Companies in the abstraction of water from the Thames. Do you mean simply that these Companies being higher up the river with their intake, would get the water first?

Witness: I take it that they have a prior claim—or would have under this Bill—up to 100 million gallons, in certain states of the river.

Sir J. BRUNNER: Does the London County Council propose to lay before the Committee a clause to prevent these Companies from getting into a preferential legal position?

Witness: That I cannot say. I have not heard the point discussed yet.

The CHAIRMAN: You spoke strongly of your objection to the proposed open aqueduct, as compared with pipes?

Witness: Yes.

Have you gone into the question of what the cost would be if iron pipes were used, instead of open conduits?—I do not know but that it would be much more expensive to have pipes.

Would not the cost be double?—I cannot say.

Mr. *G. F. Deacon*, M.Inst.C.E., was the next witness. He said, in reply to Mr. FREEMAN, that he had had 31 years' experience in his profession, and had been engaged during that period largely in water-works and sanitary engineering. For some years, he had held the position of Chief Engineer to the Corporation of Liverpool; and in this office had had to superintend the water-works and sanitary engineering of the town. The responsibility for a proper supply of water to Liverpool rested on him. Witness then went at considerable length into detail, as to the steps taken by the Liverpool authorities to improve their water supply. He pointed out that they had constructed the largest reservoir in Europe; bringing water into the town from a distance of 77 miles by aqueduct, at a cost of £2,300,000.

Mr. FREEMAN: If such precautions were taken in London as are

adopted in Liverpool and other places, do you think there would be any necessity for increasing the supply of water at the present moment?

Witness: No; I do not. The present supply would be enough for a long time. In 1894, the supply for domestic purposes in the districts of the three Companies who are parties to this Bill was as follows: West Middlesex, 28·1 gallons; New River, 23·9; Grand Junction, 40·4. In 1873, in Liverpool the water supply for domestic purposes was 27¼ gallons per day. This was under the constant supply—under the intermittent system, it had been only 24 gallons per head. The Corporation had dealt with the question of leakage, and eventually succeeded in arresting the waste, and, as a consequence, in reducing the amount of water distributed. They had adopted a method largely in use in this country and America. The system had been successfully tried in London in some few places.

What was the immediate effect of the system to which you refer?—It was brought into use in the middle of 1873. By the end of 1875, every district had been brought under the constant supply system; and we found that although the quantity of water used by the population increased, the amount supplied per head diminished owing to the prevention of waste.

The immediate effect was to reduce the quantity of leakage under each inspector?—Yes. We did not increase the number of inspectors, save in proportion to the increase of the population. The machinery was made more efficient; and each man did a larger quantity of useful work.

Were you able to do this without going inside the houses?—No; we went inside the houses in the daytime. The reduction in the supply began directly we adopted the waste-prevention system. Fears had been expressed in Liverpool that it would be a dangerous thing to introduce the constant supply system. The Chairman of the Water Committee and myself were almost alone in the opinion that it could be adopted without danger. Sir F. Bramwell was brought in; and he gave an opinion in favour of our view. As I say, no sooner had we adopted the constant supply, with an attendant waste-prevention system, than we found that the total supply of water per head diminished. In 1894, our total supply was 27 gallons per head of the population. Deducting from this the 10 gallons required for trade purposes, the domestic supply stands at 17 gallons per head. This is comparable with the figures which have been given as the supplies in the districts of the three Companies who are parties to this Bill—that is to say, in the district of the West Middlesex Company, 28·1 gallons; in that of the New River Company, 23·9; and in that of the Grand Junction Company, 40·4. There was a rise in our supply in 1895; the total going up to 29·3 gallons per head per day. It has now, however, come down again to less than it was in 1894.

These figures were due to the suppression of leakage?—Yes. I may say that the same thing has occurred at Manchester, with the difference that Manchester is a place that very early obtained stringent regulations for the suppression of leakage by inspection and general control over water-fittings. And in other places, by the adoption of like methods, they have been able to secure similar results. At the present time, I should say three quarters of a million people are supplied on this waste-prevention system.

Is it cheaper to check leakage in this way, or to pump water to allow for all leakage?—Certainly, I should say it is more economical to prevent leakage by our method than to pump more water than is required. The money we saved by preventing leakage paid the interest on the £2,500,000 spent on the new supply. In London, at least 5 gallons per head of the population could be saved by the adoption of our waste-prevention method, and that without putting the consumers to any inconvenience. The system could be put into operation in a couple of years; and if it were adopted, it would put off any difficulty as to an increasing supply of water in London for the next ten years.

Several questions being put to the witness on the subject of the filtration of water by the three Companies promoting the Bill,

The CHAIRMAN said: We have no question of increased filtering power before us; and we have, therefore, left it untouched. What we have to consider is an application for storage reservoirs. The question is, Are these reservoirs necessary in the interests of the public in the districts of the promoting Companies?

Sir J. BRUNNER: Ought these reservoirs to be included in our minds in the 15 or 20 days' supply referred to by General Scott?

Witness: Wherever you are speaking of storage for meeting irregularity of supply, they ought to be included.

Tuesday, June 16.

On the sitting of the Committee to-day,

Mr. *Deacon* was further examined. He said he now put in, in the form of a table, certain comparative information which the Chairman had asked for at the last sitting, as between the three Companies who were parties to the Bill and the water undertaking of the Corporation of Liverpool.

Mr. FREEMAN: Have you considered what the effect of the proposed new reservoirs at Staines would be in prolonging the minimum flow of the Thames at Teddington?

Mr. LITTLER: There is not a word about this in the petition of the London County Council.

Mr. FREEMAN: We say, in paragraph 9 of our petition, that the future water supply of the Metropolis could be obtained elsewhere than from the Thames, and that the abstraction of the water you propose would be prejudicial to the river.

Mr. LITTLER: The Standing Order states that there must be a specific allegation; but yours are only general allegations against taking water from the Thames. They are what we may call political allegations, but not as regards specific engineering details.

The CHAIRMAN (to Mr. Freeman): What question would you ask?

Mr. FREEMAN: Whether, if the works are carried out as proposed, they will materially increase the number of days in which the water at Teddington Weir will be at the minimum flow.

The CHAIRMAN: I think that question can be put.

Witness thereupon answered in the affirmative. Continuing, he said that in the majority of days there would be a reduction in the flow for a further period. In 1893, the flow fell to below 300 million gallons at Teddington. It went on in the summer months, and up to the 10th of October. During the whole time, if the reservoirs had been in existence, there would have been a diminution in the flow of the river.

Mr. FREEMAN: There would be a serious increase in the number of days?

Witness: Yes; and that would also have been the case in 1885 and 1887, to a considerable extent.

I believe I am right in saying that this particular Bill was not referred to, or considered by, the Royal Commission?—I think it was only considered by the Committee in the sense that they evidently assumed, by the last paragraph in their report, that the condition of the river would not get worse, but would, by some such project as this, be maintained or even improved. But that will not be the case under the scheme before the Committee.

Witness proceeded to refer to diagrams which were exhibited on the walls, showing approximately the number of microbes in Thames water in certain years, and during certain seasons of those years.

The CHAIRMAN pointed out that the Committee were not concerned with the question of the purity of Thames water.

Sir J. BRUNNER, in reply to this, said the evidence merely went to show that, so far as microbes were concerned, the water would not be benefited by the proposed storage.

Mr. FREEMAN said the point was that the scheme of the Bill was defective, inasmuch as it would not give a really good water, as it professed to do.

The CHAIRMAN said this was beyond the control of the Committee. They had to take it from the Royal Commission that, according to the evidence of Dr. Frankland, Thames water was fit for consumption.

Mr. LITTLER remarked that the whole question was inquired into by the Royal Commission.

Mr. FREEMAN said the contention of his clients was merely that the water would not be made purer by being admitted into the reservoirs. They did not do what they professed to do—namely, take water into the reservoirs when it was in its best condition. His object was to show that the consideration of this instalment of the Thames storage scheme should be postponed until the whole question could be dealt with.

The CHAIRMAN, after further conversation, determined to admit the evidence; and Mr. Freeman thereupon said that the answer he wished to have placed on record was that the scheme did not do what it professed to do, and that the water which would be taken into the reservoirs would be as bad as that which would be left out.

Cross-examined by Mr. LITTLER, witness said that he was not examined before the Royal Commission on this question. He gave evidence to show that certain reservoirs would be inadequate for the purposes intended; and the Commission accepted his view. He was the last witness before the Staines Reservoirs scheme came on.

Mr. LITTLER here drew attention to certain passages in the evidence given before the Commission, in which Mr. Deacon had said that he had heard the statements which had been made with regard to the Staines scheme.

Witness acknowledged that he had made a mistake. He explained however, that, when he gave his evidence, he had not had an opportunity of analyzing the Staines scheme. In reply to further questions, he said that the saving of water by the waste prevention system adopted at Liverpool had been permanent. There had been an increase in the consumption of water at some periods, by reason of a quantity being needed for purposes for which it was not used previously—especially trade requirements. The trades were taking more water now, because it was sold at a cheaper rate.

Mr. LITTLER: Do you deny that in July, 1890, the consumption was 22·09 gallons per head per day in Liverpool?

Witness: I have not the monthly returns by me; but I have those for the whole year.

I am taking this from the reports made by the Chairman of the Water Committee to the Liverpool Corporation, from the Water Engineer's periodical reports. In 1890, the consumption was 22·09 gallons; next year it was 22·96 gallons; in 1892, 24·95 gallons; in 1893, 28·66 gallons; in 1894, 28·22 gallons; and in 1895, 30·77 gallons?—The year 1895 should be eliminated in all cases, because of the frost. But if the other figures are correct, the increase is due to trade supplies. You will find that the great increase in 1895 was extinguished at the beginning of this year. The supply was brought back to less than it was before.

You utterly deny that 35 gallons per head per day ought to be the standard supply in London?—Let me explain.

Mr. LITTLER: Answer the question?—I cannot answer a question put in that way.

The learned Counsel resumed his seat.

By a MEMBER OF THE COMMITTEE: Liverpool was exclusively a water-closet town. In 1872, it was two-thirds or three-fourths a water-closet town. If there had been an increase in the consumption, this would be one thing to account for it.

By Sir J. BRUNNER: The New River Company had already storage capacity for 37,540,000 gallons of water; the amount supplied by them being 32,000,000 gallons; the West Middlesex Company had storage for a day's supply, or 19,422,000 gallons; and the Grand Junction Company had storage for 76,000,000 gallons, or three days' supply.

Mr. LITTLER: We do not know where these reservoirs are.

Mr. J. STUART: It is now suggested that the Water Companies do not know where the storage reservoirs are—that they do not know, for instance, that the Grand Junction Water Company have a storage reservoir of the capacity of 76 million gallons. This is a serious position. I would ask Mr. Littler if the existence of these reservoirs is seriously denied?

The CHAIRMAN: How can it be denied? The facts were stated before the Royal Commission.

Mr. LITTLER: I am not disputing what was put before the Royal Commission, but I am disputing evidence like this: "Q.—How many days supply is that eqnal to? A.—74 days' supply, or 6 per cent. excess."

Mr. STUART: Does Mr. Deacon assert that, on page 7 of General Scott's report, it is brought out that 76 million gallons in the case of the Grand Junction Company is available as storage? Is this storage

water available for supply, or is it water in process of being filtered and not available for supply?

Witness: It is available for supply. It is water which, after filtration, is stored to meet the irregularities of supply from day to day.

Mr. *E. B. Taylor*, M.Inst.C.E., who was the next witness called on behalf of the County Council, said he had had considerable experience in connection with water undertakings; having been professionally engaged upon the Bristol, Shrewsbury, Colne Valley, Rochester, and Chatham, and many other water-works. He was well acquainted with the wants and supplies of the London Water Companies, and the conditions of the flow of the Thames; and he had considered very carefully whether there was urgent need for a further supply in the case of two Companies before the Committee who were drawing water from the Thames—namely, the West Middlesex and Grand Junction Companies. He had come to the conclusion that there was no urgency, and would be none for ten years to come. He had heard Mr. Binnie, the Engineer to the London County Council, give his evidence; and he agreed with him thoroughly as to there being no need for the works proposed under the Bill. Asked whether he agreed that the rate of the increase in population and of supply per head were the two factors which had to be considered in estimating the water supply necessary for the future, witness replied that these two factors were invariably considered, this being the only sound way of calculating the question. As to the difference between the average and maximum supply required to be given, a certain amount of storage would equalize that. As to its extent in the case of the London Companies, he had tried it for the last year, and he thought that storage equal to twelve days of the average supply would meet all the maximum wants that had occurred during the past few years. Sometimes it was ten and at others nine days; but twelve days was the highest. The West Middlesex Company had an authorized storage for 24¼ days; and the Grand Junction also had a large margin. In their case, the maximum quantity might be taken as a basis, and still show a large excess; so that there was not the same need of storage. In reply to further questions, witness said he had made gaugings of the River Thames at many parts, among others at the Bell Weir; and if his figures were compared with those relating to the gaugings of the Thames Conservators as to the flow at Teddington, the result as to ratio between the flow at the Bell Weir and at Teddington was not that which Mr. Middleton had given.

Professar *W. G. Unwin* said he had been Professor of Engineering for more than 25 years, and had given special attention to questions connected with hydraulics. He had been Professor of Hydraulic Engineering to the Royal College at Cooper's Hill. He had made a special study of the flow of the Thames. In 1884, he gave evidence before the Committee on the Metropolitan Sewage Discharge, as to the action of the upland water on the tidal part of the river. Asked what was his opinion of the effect of the diminution of the flow of the upland water on the tidal part of the Thames, witness said the purity of the water in the upper part of the tidal Thames was almost entirely dependent on the purity of the upland water.

The CHAIRMAN objected to going into the subject of the purity of Thames water.

Mr. BALFOUR BROWNE pointed out that this was a question of the purity of the Thames in London itself—a matter which was never before the Royal Commission at all. In the Lower Thames, below Teddington, there was constant and increasing impurity coming into the river. This impurity at present was displaced by the scour of the water passing over Teddington Weir. To reduce the quantity of water passing over the weir, therefore, would be to injure the river.

Mr. *Collins*, the Engineer to the Grand Junction Water Company, was here recalled, at the request of Mr. LITTLER, to give evidence as to the reservoirs of his Company. He said their service reservoirs had a capacity of 37,540,000 gallons. They regulated the daily supply, which varied hourly. It was found that the storage had always to be kept at its maximum, subject to these variations, so as to maintain the pressure in the mains. This storage was spread over five or six reservoirs; and each of these had to have its pressure maintained by being kept full.

Mr. LITTLER: If you did not keep up the pressure, you would not be able to supply people living in the highest part of the district, and would never be able to put out a fire?

Witness: That is so.

Can the 37 million gallons be counted on, or made use of, as storage in the ordinary sense?—Not at all. Instead of being called storage, it should be called a service reservoir system. It is necessary to keep it up to a certain standard; and beyond this standard, it cannot be reduced without risk. Without the proper amount of pressure, the danger from fire would be very great in such a district, say, as Wood Street, where there is property of the value of many millions. If the 37 million gallons were treated as storage, the Company's works would be greatly damaged. It is impossible to regard this water as storage.

Mr. BALFOUR BROWNE: Then I understand that you have a service reservoir that you cannot draw on.

Witness: I did not say that.

You want to keep up the whole 37 million gallons, and not draw off a drop in case there should be a fire in Wood Street?—I did not say so.

Did you ever want 37 million gallons for a fire?—I have never known a fire take that quantity. Still, it might be needed.

Mr. LITTLER: But the service reservoir has to be there in case of fire, has it not?

Witness: Certainly.

There is a distinct difference between a service reservoir to provide against these accidents, and a storage reservoir to provide for a daily supply of water, is there not?—Yes.

Are your reservoirs more than are necessary for the daily service?—No. The blunder which has been made has been in calling them storage reservoirs.

Mr. BALFOUR BROWNE, addressing the Committee for the London County Council, said the question before them was simple. Must they pass the preamble of this Bill—was there any necessity to grant the Companies new powers; and, if so, was this the right way to give them. It was unnecessary to remind the Committee of the instructions given by the House, which were to the effect that the works contemplated were not to be allowed unless they were urgently needed in the interests of the public; the object of the House, no doubt, being to prevent anything being done to prejudice the future settlement of the water question by the Board which Parliament contemplated creating. This, he maintained, was not a *bonâ fide* Bill to deal with the question of urgency. It was intended, not for the purpose of supplying the wants of these districts—in whose regard there would be no question of urgency for ten years to come—but was for the purpose of forestalling the action of the Trust which might be established by the Government Water Board Bill. If there were any emergency, everyone admitted that it could be met without spending a million of money. The County Council had said that, in such an event, they would rather that the Companies should have power to take a few extra gallons out of the Thames, than that they should spend a million of money to enhance the value of their property against a possible purchaser in the future. As was known, it was contemplated that the new Water Board should purchase these properties; and the Bill was for the purpose of increasing their value. It was said it was founded on the report of the Royal Commission; and that this report must be taken as a sort of gospel. Well, the opponents of the Bill were prepared to do so; but the promoters would not. Mr. Binnie's figures were founded on the standard of 35 gallons a head per day being required in London; but the promoters said that this standard was wrong, and that one Company should be allowed to provide for a supply of 64 gallons per head per day. Having pointed out the limited character of the reference to the Royal Commission, he submitted that the carrying of the Bill would make the realization of the object of the County Council—which was the establishment of a new source of supply—more difficult. Every penny spent on the Thames, was a sort of anchor to keep them there. He pointed out that the figures put in showed, on a safe calculation, that the three Companies who were parties to the Bill had an average supply of 105,830,000 gallons per day—sufficient for a population of 3,023,714. The population now supplied was only 2,140,527; showing that there was a margin of supply for 883,187 persons, or for an increase of 41·2 per cent. The Companies said there was an emergency; but he contended that they were not to be believed. By their own figures, their case was more favourable than it should be; for they calculated that the waste which was now taking place would go on, while there was every reason why it should not, and why steps should be taken to prevent it. They also calculated that the increased consumption would continue in the future as in the past, which was also an unfair assumption. The evidence of Mr. Binnie and Mr. Deacon was worthy of careful consideration. The last-named gentleman had dealt with leakage; and speaking not as to a future supply, but as to a question of emergency, he had shown how easily the Companies could meet an emergency by stopping waste. They could save, said this gentleman, 3 million gallons of water per day; and why should they not do it? This witness had had considerable experience in Liverpool; and his evidence was directly in opposition to the contention of the Companies, which was that a constant supply of water would mean a large increase in the supply. Mr. Deacon had shown that, as the Liverpool system was changed from an intermittent to a constant one, so had the supply been reduced. He had shown that more than 5 gallons per head per day could be saved in London, which would put off the necessity for new storage works for ten years. Mr. Middleton, the Engineer to the promoters, had admitted that if the waste at present going on could be checked, the Companies would have sufficient water to last them fourteen years. Besides this, the Committee had had put before them objections to the Bill founded on the questionable character of the site chosen for the reservoirs, the flooding of the district, the open conduit, and so forth; but all these were subsidiary to the main point that there was no emergency, or none sufficient to entitle the Committee to pass the Bill. It must be remembered that there were other Bills before the Committee, to enable the Companies to increase their works, and that their witnesses had stated that further water might be taken from the Thames by means of existing works. Mr. Hunter had said that, if he could get the water he wanted, he would not require new works, though he had admitted that further water could not be taken from the Thames without injury to the river. But Mr. Hunter was not the custodian of the river. In conclusion, he urged the Committee, in the interest of the water consumers and of the ratepayers of the Metropolis, to reject the Bill.

Mr. MILVAIN, for the Corporation of the City of London, also addressed the Committee. He disclaimed all idea of wishing to harass the Water Companies. He urged the necessity for the adoption of the sinking-fund clause (in favour of which the Committee had declared); and submitted that the proposed works of the Water Companies would lessen the flow of the river, lead to a greater deposit of solid matter and refuse in its bed, and entail a large amount of new scavenging work upon the Corporation, as the Port Sanitary Authority. The money paid to the Thames Conservators for the water taken from the upper river was not expended in dredging in the lower river; and it was the ratepayers of the City who had to find the funds for removing accumulations in the river from Teddington Weir to the Nore. In dry seasons, one-third of the natural flow of the water over Teddington Weir had been abstracted by the Water Companies. Under the present Bill, more water would be taken, and the scour of the lower river would be injured. He suggested that the Committee should secure the Corporation by putting in the Bill—if the preamble were proved—clauses declaring that, as the flow of the river approximated to the minimum flow of 250 million gallons a day, so the quantity of water the Companies took should be decreased.

Mr. WEDDERBURN, for the Hertfordshire County Council, argued against the case of the New River Company. He adopted, as against this Company, all the statements used by Mr. Balfour Browne in opposition to the Bill. He maintained that, in the first place, no urgency had been shown for the Bill; and, secondly, that even if there were urgency for an increased water supply, the works proposed had not been proved suitable. The New River Company had water sufficient to last them 10 years on one calculation, 38 years on another, and over 70 years on a third.

Mr. *T. Fenwick*, M.Inst.C.E., examined by Lord R. CECIL, said he had had a large experience in connection with water-works. He had

considered the Bill, and the circumstances of the county of Middlesex. The Thames was the natural source of supply for the county; and if Middlesex obtained powers to control the water supply, the river was the source to which they would look. He thought the proposed works would deprive Middlesex of a large portion of their rating area.

Lord R. CECIL, on behalf of the Middlesex County Council, then addressed the Committee in support of the foregoing evidence. He denied that the scheme of the Water Companies was necessary in the public interest. The question was not whether a Welsh supply should be adopted, but whether the powers now sought could be postponed. He thought they could, pending the establishment of a Trust for the consideration of the London Water Supply; and he, furthermore, maintained that the instructions the House had given to the Committee really meant that nothing was to be prejudiced until the Trust had had an opportunity of considering the matter. He submitted that the Bill had not been designed to meet an emergency, but for the purpose—perfectly legitimate, no doubt—of bringing about the permanent extension and enlargement of the Companies' works. As it stood originally, it was part of a much larger scheme. Middlesex had a right to say that they should have the first drink of the water which it was proposed to take to London; but a provision to bring this about would be difficult to insert in the Bill. This showed the great inconvenience of dealing with the measure as one of emergency, when it really ought to be part of a general scheme. He concluded by contending that no urgency had been shown for the Bill.

Wednesday, June 17.

On the resumption of the proceedings this morning,

Mr. POPE replied on the whole case on behalf of the promoters. He said it would not be necessary to occupy the Committee at great length, for he owned he could not do it advantageously. He had gone through the evidence given before the Committee, and must frankly confess that some of it he did not understand. He shared the arithmetical infirmity of other members of his profession, in the mastering of the columns and columns of figures which had been put in during the inquiry. But there were general considerations which seemed to him to lie at the basis of the duty of the Committee, in support of which he would say a few words. He would, in the first place, urge upon the Committee the true aspect of this question, from the point of view of the water consumer—not that of the Companies, nor of the proposed future Water Authority. Mr. Balfour Browne on the previous day had claimed to represent the water consumer; but he (Mr. Pope) could not admit his learned friend's claim. It seemed to him that the parties the learned gentleman represented were the ratepayers, who were anxious to purchase the Water Companies, and who, so far as the interests of the consumer were concerned, would not object to incur some risk, if by so doing they could cheapen the Companies. He (Mr. Pope) did not propose to ask the Committee to consider the interests of the Companies, except so far as they were entitled to the consideration of Parliament to enable them to discharge the duties which Parliament had cast upon them. Nor would he ask the Committee to consider the interests of the future purchasing authority—if such eixsted—as an element to be taken into consideration against the interests of the population who used the water. This being the view which he proposed to ask the Committee to consider, what were the requirements of the water consumers in the districts of these various Companies? The provision which should be made for the requirements of the water consumer appeared to him to be that in one way or another—the method of making that provision being, of course, a debateable question—there should be water sufficient for such period as was thought reasonable so as to secure for the water consumer the maximum amount which he used at any particular time. It might be that this provision could best be made by storage, or it might be that it could best be effected by increased supply; but the figure which it seemed to him they had to deal with was the maximum requirement of the water consumer. The consumer was entitled, if he wanted to have water and was willing to pay for it, to get it, whether the immediate demand were in excess of the average or not. Then the question would arise, For how long should this provision be made? He did not propose to discuss this point at any length, because it must be obvious that at all events the provision must cover the period within which it was not possible that an alternative supply of water could be brought into London. Surely the water consumer was entitled to have water up to any date at which another system of supply could provide for his wants. To his mind, the period should be fifteen years; for they must remember that, if a new water authority were established in the Metropolis, they would require a period of time for deliberation, and that even after they had decided, they would need another interval to arrange how best to carry out their plan. These intervals could not be given, and the contemplated work carried out, within a period of fifteen years. Therefore, he started with the position that, in accordance with the instructions which had been given to them by the House of Commons, the Committee must provide for the water consumer such maximum quantity of water as he might require during the next fifteen years. Supposing the Welsh, or any other scheme were adopted and brought into play, how long would it last? So far as he had seen the calculations, after its introduction it would only last thirty or forty years; and, sooner or later, the inevitable consequence must be that the Water Authority, whoever it was, would find it impossible to dispense with a supply from the Thames Valley. This seemed to him the necessary deduction as the result of this inquiry. Suppose they had a Welsh scheme, how long would it last? When it was exhausted, where would they go? It seemed to him it would be in the highest degree culpable to leave the Thames altogether. They would have to come back to it in the middle of the next century—for a supplemental supply, if not as the main source. But he felt that the Committee had received certain instructions from Parliament, by which they were bound; and that, in consequence, they would only make temporary provision, without going into considerations as to the future. The proper view, therefore, as it seemed to him, which ought to be taken was what would be the requirements of the consumers in these three districts in the next fifteen years? What were the maximum requirements? As he had said, he suffered from an arithmetical incompetency; but there were two or three figures before the Committee which seemed to him, practically, all that they need deal with. The maximum requirements were: For the West Middlesex Company, 24,300,000 gallons, in round numbers, per day, taking the daily average of the maximum week's supply; for the Grand Junction Company, 22,250,000 gallons; and for the New River Company, 45,270,000 gallons. This ought to be taken apart altogether from controversial questions of water politics, and of trying to enhance or depreciate the value of the Companies' properties. The water consumer, independent of these considerations, was entitled to ask that he should have this quantity of water in the three districts. The Chairman himself had said the quantities would be 20,000,000 gallons for the West Middlesex Company, 19,000,000 gallons for the Grand Junction Company, and 38,000,000 gallons for the New River Company.

The CHAIRMAN: The last figures we had were the average for the month and the week. The maximum week in the case of the West Middlesex Company gave 22,750,000 gallons a day; in that of the Grand Junction Company, 21,650,000 gallons; and in that of the New River Company, 45,482,000 gallons. The monthly maxima were 21,000,000, 20,000,000 and 39,000,000.

Mr. POPE said the Chairman had been taking the figures for 1894, while he (Mr. Pope) had given those for 1895. The difference did not alter his line of argument at all. The question was what would the requirements of the Companies be in fifteen years' time? Taking the rate of increase suggested by the Companies during the past four years, he calculated that the 24 million gallons of the West Middlesex Company would be extended, in 1911, to 41 million gallons; that the 22 million gallons of the Grand Junction Company would be extended to 34 million gallons; and that the 45 million gallons of the New River Company would be extended to 80 million gallons. It must always be borne in mind that no provision could be made instantly, but that there must be delay in carrying out the works. To meet this, the West Middlesex and the Grand Junction Companies had each their supply of 24½ million gallons from the Thames, and the New River Company had their supply from other sources of nearly 47 million gallons. The present requirements of the West Middlesex Company were 22 million gallons according to one set of figures and mode of calculation, or 24 million gallons according to another set of figures. They were, therefore, close to the end of their supply. The Grand Junction Company were better off; it was not water they wanted, but storage. They were within 2¾ million gallons of the end of their resources; and the New River Company were close to the margin of their supply—their maximum requirements being 45 to 48 million gallons, and their available supply 46½ million gallons. Practically, the Companies were at the end of their available means of supply. They certainly would be, if the increased consumption of the past few years went on until the new works contemplated in the Bill could be completed. If the Committee thought it worth while to starve the consumers, in order to reduce the value of the property of the Companies and save the pockets of the ratepayers when some purchase scheme was carried out, well and good. But his contention was that such a consideration should not enter into the calculations of Parliament at all. His proposal—or that of his clients—was that the most reasonable and scientific way of dealing with the question would be to give the Companies the right to take additional water from the Thames at the time when the river could best spare it, and to store it so as to enable them to meet the maximum demand for water when it arose. He had thought that the County Council were themselves in favour of the principle of storage. What was proposed was to take water from the river when it could best stand the loss of it, for the purpose of storing it in reservoirs, and to make it available at the moment the pressure arose. The proposed reservoirs would hold 60 days' supply of 45 million gallons, or 2500 million gallons. Each of the Companies would get 15 million gallons a day. In fifteen years' time, the West Middlesex Company would want 41 million gallons; and the 15 million gallons proposed would not give them a large surplus. The Grand Junction Company would be better off; while the New River Company would have only a portion of the supply which it would be necessary for them to have. The Companies would be limited to an intake of 100 million gallons a day; but this amount could only be abstracted on a few days in the year—not more than sixty—for not a drop could be taken when less than 250 million gallons was flowing over the Bell Weir. There could be no doubt that this 15 million gallons would be required by each of the three Companies within the next fifteen years; and he asked the Committee to say whether the best way of supplying it was not by means of storage—the water being taken from the Thames when the river could best afford to part with it. With regard to waste, it might be that, by vigorous application of a waste prevention system, the Companies could economize their water; but the Committee must not lose sight of the fact that the tendency on the part of the consumers was always to revert to old habits. Moreover, it must be borne in mind that it would take time to apply such a system. Mr. Deacon, who was so enthusiastic in his advocacy of waste prevention, had not shown that the Water Companies were not adopting every means in their power to prevent waste. Something had been said as to one Company selling water to another, to afford a remedy for the difficulties which might arise in the next fifteen years. But there was no statutory power to compel one Company to sell to another; and, then, there were other Companies to be considered than the three before the Committee. One at least of these was drawing in excess of the maximum statutory quantity from the Thames. A further contention of the opponents of the Bill was that power might be given to the Water Companies to increase their present intake from the Thames; but he maintained that the Committee could not confer such a power on the Companies.

The CHAIRMAN asked if the Committee were to understand that they could not amend the Bill so as to enable the Companies to take more water from the Thames.

Mr. POPE replied that the Bill could not be so amended without a violation of the Standing Orders of the House.

Sir J. BRUNNER inquired if arrangements could not be made with the Thames Conservancy Board, to enable the Companies to increase their intake from the Thames.

Mr. POPE replied in the negative.

Sir J. BRUNNER: Who could prevent it?

Mr. POPE: The riparian owners.

Sir J. BRUNNER: The point is one as to which I will take the earliest opportunity in my power of satisfying my own mind.

Mr. POPE asserted positively that provision could not be inserted in the present Bill for enabling the Companies to increase their intake from the Thames, without a violation of the Standing Orders of the House. If such provision were inserted, it might imperil the future of the measure. Section 296 of the Thames Conservancy Act of 1894, prohibited the Companies from taking more water from the Thames than their statutory powers allowed. In conclusion, he asked the Committee to sanction the present scheme, not because it was by any means perfect, and such as the Companies would present if they were free and Parliament had not given precise instructions to the Committee, but because it was in compliance with the report of the Royal Commission, and only sufficient to give the Companies the fifteen years' supply they wanted.

Mr. FREEMAN said he could not admit that there was force in Mr. Pope's technical objection.

Mr. POPE: If the Committee desire it, I will give evidence on the point; but irrespective of whether it can be done or not, I say it ought not to be done.

This concluded the case.

The CHAIRMAN: We have now to consider whether we will give a decision on the Bill before us before we hear the case for that of the New River Company, in which the promoters seek powers beyond those contained in the Staines Reservoirs scheme. The remaining Bill—that of the Southwark and Vauxhall Company—is not effected, I presume.

Mr. POPE: No; and the New River Bill cannot come on to-day.

The CHAIRMAN: I suppose nothing we could give you in this Bill would choke you off the other—I do not say that we mean to give you anything?

Mr. POPE: If you gave us anything in this Bill, it would reduce the immediate necessity of the case—it would reduce our requirements under the New River Bill.

The CHAIRMAN: But you would want to go on with the Bill on other grounds?

Mr. POPE: Yes.

The room was then cleared. On the re-admission of the public,

The CHAIRMAN said: The Committee have settled to come to a decision on the Staines Reservoirs Bill at once; leaving over the question of the New River Bill. We think it will be for the convenience of all parties if we ourselves meet on Friday to come to that decision; postponing the New River Bill until Tuesday. We shall be able to give our decision on the Staines Bill on Tuesday morning.

Tuesday, June 23.

On the commencement of the proceedings to-day,

The CHAIRMAN said: The Committee will be prepared to pass the preamble of this Bill provided that certain paragraphs are eliminated therefrom, and certain alterations and additions are made in the clauses. As regard the preamble, the Committee see no reason for the retention of the recitations contained in the first, second, third, fourth, and seventh paragraphs, which link this scheme with what is deemed to be the scheme of Messrs. Hunter and Fraser set before the Royal Commission. The Committee are not prepared to grant power to purchase "additional lands," except such parts as are necessary for the construction, supply, and discharge of the reservoirs. Compulsory powers for the purchase of land must be exercised within three years, and not within seven years, as in clause 32. As regards the extent of the two proposed new reservoirs in the parish of Stanwell, the Committee will probably desire (in considering clauses) to have further evidence as to the relative cost of these and somewhat similar reservoirs; also on the question of how far the mimimum flow of water over Bell Weir could be increased if the two reservoirs remain at their proposed capacities, with a somewhat diminished outflow; and also as to the relative cost of the proposed conduits and pipes laid down under the surface of the ground. The works, we think, ought to be completed within seven years, and not within ten years. And before finally deciding upon the size of the reservoirs and the quantity of water to be delivered down the conduit or pipe, the Committee feel that there should be some statutory pledge given by the Grand Junction Company that a specified proportion of the water delivered on to their filter-beds should be stored water taken from the reservoirs proposed under the Bill. The Grand Junction Company, I need not remind the parties, are very deficient in storage, and are rather better off for water than either of the other two Companies. The power to take water out of the River Thames might be limited to 80,000,000 gallons per diem. The power to forward water down the pipes or conduit might also be limited to 30,000,000 gallons per diem on the average of any one month. The Committee are of opinion that, in case of emergency, the Companies, on receiving the consent of the Local Government Board, should be permitted to increase their drawings from the Thames, at such times as the Board may authorize, to any quantity not exceeding 100,000,000 gallons in any one day; and the discharge from the reservoirs, to any quantity not exceeding 45,000,000 gallons per diem on the average of any one month. The Committee see no reason for allowing water to be taken out of the conduit. With regard to the Thames, the Committee are of opinion that an acknowledgment—not necessarily on the same scale as the sums now paid by the various Companies—should be paid to the Conservators. It would be a sum which, I think, the parties will be able to agree upon if the Bill goes forward. We think that this supply of water from the Thames should not secure to the promoters any priority above existing or future powers granted or to be granted by Parliament to take water from the Thames. The Local Government Board point out that there are no powers to appoint officers and staff. We leave the promoters to deal with this question. The Committee are of opinion—in accordance with the Local Government Board's report—that the accounts should be audited as the water accounts are at present audited. The Committee are of opinion that the issue of stock should be as already provided for in the Lambeth Water Bill of this session, with the usual sinking-fund clauses; and a clause will have to be brought up to the effect that, for the purposes of the sinking-fund, one-third of the capital subscribed from time to time by the promoting Companies should be deemed to be capital raised by each Company for its own special purposes at the rate of interest at which such joint capital has been raised for the joint undertaking. We think that the debenture stock should, as pointed out by the Local Government Board, be redeemable at par in 25 years—the usual clause latterly. In the case of the New River Company, the income from real and leasehold estate would not come into the income account of the Company dealt with by the sinking-fund clause. I would point out that there is a "due diligence clause" in the Southwark and Vauxhall Act, which it might be well to put in the Bill if it goes forward. The Committee are of opinion that the principle embodied in clause 24 of the Southwark and Vauxhall Act, 1884, should be embodied in the Bill—it would be a clause to the effect that, in case any of the three subscribing Companies should be purchased by any public Corporation or Trust within seven years from the passing of the Bill, no additional value should be deemed to have accrued to such Company by reason of the supply of water secured to it by this Act. Those are the observations that the Committee have laid down as a condition of the passing of the preamble of the Bill. Of course, it would be most unfair to either party to ask them to come to a decision with reference to going on with the Bill at this moment, or as to whether they will appear on the clauses or not. I think we had better discuss the clauses on Thursday.

Mr. BALFOUR BROWNE: It would be convenient if the parties could see the decision of the Committee in print before attempting to say anything upon it.

Mr. POPE: The secret of the result of the deliberations of the Committee has been so well kept that this is the first time we have heard what it is. Of course, it would be impossible for us, off-hand, to decide what the effect of conditions so numerous and important will be. We certainly shall require time for consideration.

The CHAIRMAN: Take until Friday, if you desire it.

Mr. POPE: That would be better than Thursday.

The CHAIRMAN: Gentlemen at the other side of the table will, I am sure, give us credit for having paid great attention to the details of this case. They will remember also that we have been bound by negative instructions from the House of Commons, which it has been difficult to interpret. If our instructions had been positive (instead of negative) our duty would have been a great deal simplified.

Mr. POPE: The Bill, I understand, will stand over until Friday; and, in the meantime, we will consider how the conditions laid down by the Committee can be brought up embodied in clauses, or what effect the decision of the Committee will have upon the Bill.

Friday, June 26.

On the resumption of the inquiry this morning,

Mr. POPE said that, since the adjournment on Tuesday, the Counsel for the three Water Companies had very carefully considered the statement the Committee had made as to the views they (at all events at that time) desired to express; and he would say at once that the course the Companies would ask the Committee to pursue would be to proceed with the Staines Reservoirs Bill, because they anticipated, from the statement the Chairman had made, that they would arrive at the production of a Bill which, though not all they desired, still appeared so far satisfactory that the promoters would not be justified in disregarding the remarks of the Committee. If they obtained such a measure, they hoped they might be able, on the part of the New River Company, to jettison a considerable portion of the most contentious part of the Bill of the Company. In this way they would save the time of the Committee, by avoiding some part of the discussion which, if the Bill proceeded in its entirety, would have to be gone into. He would now deal with the Staines Reservoirs Bill, go *seriatim* through the points suggested, and state how the Companies proposed to deal with them. They did not understand that upon two of the most vital points of the Bill the Committee had arrived at an absolute decision, but had shown a desire to communicate their wishes to the parties. For instance, as to the size of the reservoirs and the amount of water to be taken both for supply and from the river, and so on, the terms of the statement itself were that the Committee would be willing to receive further evidence on these two points—the decision not being absolutely final. Some of their decisions were final; and he was inclined to hope that the parties might be able to accept the view of the Committee where it had been expressed as a finality, because they were sensible that the Committee were bound by the instructions they had received from the House of Commons—instructions which were more or less difficult of construction to everyone who had read them. On the settlement of the Staines Reservoirs Bill would depend the amount of jettison which could be accomplished in the New River Bill, because he had been anxious not to retain in the Bill, if it could be avoided, any of the points which appeared likely to occupy a great deal of the time of the Committee, because they were the most contentious matters upon questions hardly referable to the instruction from the House. As to the part of the decision in regard to the preamble of the Bill, that must be left entirely to the Committee, and he had no observation to make upon it; and as to the clause containing powers for the purchase of "additional land," that would be struck out according to the wish of the Committee. Also, the Companies accepted the view that the compulsory powers for the purchase of land should be exercised within three years, and not seven. With regard to the extent of the two proposed reservoirs in the parish of Stanwell, the Companies would give further evidence as to the relative cost of these and smaller reservoirs. They would also submit evidence as to how the minimum flow of water over the Bell Weir could be increased if the two reservoirs remained at their proposed capacities, with a somewhat diminished outflow; and as to the relative cost of an open conduit and underground pipes. They would be able to show, he thought, that the saving of cost by constructing a small reservoir would be out of proportion to the advantage which

would be gained by a small additional expenditure on extra storage; and, further, that the calculation of the necessary size of the reservoirs for carrying out the purpose of the Bill had been based upon the supposition that 250 million gallons per day would be the quantity of water passing over Bell Weir. Any increase of this quantity would, in order to preserve what he might call the balance of the scheme, require larger reservoirs than the Companies had contemplated, because it would decrease the number of days in which water could be taken from the river for the purpose of filling the reservoirs.

The CHAIRMAN: If the flow out of the reservoirs is decreased, how then?

Mr. POPE said he should offer engineering evidence to show that this would be a mistake. The draw from the reservoir would not affect its size in relation to the amount of water to pass over Bell Weir. The Committee said: "The works, we think, ought to be completed within seven years, and not within ten years;" and to this the promoters assented. On the point as to the stored water flowing over the filter-beds of the Grand Junction Company, the Companies respectfully asked that, when they came to discuss it, the Committee should explain the meaning of their decision; and as to the statement of the Committee that the power to draw water from the Thames should not exceed 80 million gallons per day, further evidence would be given as to the quantity which must be taken in order to preserve the balance of the scheme. It was proposed by the Committee that the flow down the conduit should not be more than 30 million gallons per day; and the Companies would not be prepared to throw up the Bill if this part of the decision remained. But they hoped to induce the Committee to modify their view on the point. As to the question of the increased drawings from the Thames with the consent of the Local Government Board, evidence would be offered to show that the decision of the Committee on this point, coupled with the decision as to the flow down the conduits, would not give the Companies an adequate supply of water. Then the Committee said that no water should be "taken out of the conduit before it reached the end of its journey." It would be shown that the proposal of the Committee would lead to unnecessary expenditure for pumping, in place of allowing water to flow from the Thames over the filter-beds.

The CHAIRMAN said the Committee had inserted the recommendation because of the strength of the evidence in favour of storage.

Mr. POPE: Yes, storage for the purpose of maintaining a supply in times of necessity.

The CHAIRMAN: The evidence is to the effect that all water should be stored before passing on to the filter beds.

Mr. POPE: I am not conscious of anyone giving evidence of that kind.

The CHAIRMAN: It was given before the Royal Commission.

Mr. POPE said he would not argue, but would ask the Committee to receive evidence on the point. In regard to an acknowledgment being made to the Thames Conservators in respect of the water taken from the river under the Bill, the Companies agreed to the decision of the Committee, which laid down that the Companies should secure no priority above existing or future powers granted, or to be granted, by Parliament to take water from the Thames. Also, they had no objection to dealing in the Bill with the question of the appointment of officers and staff, and also with the auditing of the accounts of the new undertaking on the same principle as the accounts of the Water Companies themselves. As to the sinking-fund, the Companies did not feel at liberty absolutely to decline the proposal—not even the New River Company; but they would ask the Committee to consider the question as to when the payment to the sinking-fund should commence, and in respect of what capital it should be paid. This would be a matter of detail, to be gone into when the sinking-fund clause came to be discussed, because it seemed obvious to the promoters that there should be some modification, not of the principle but of the phraseology of the provision. They accepted the principle, and asked for it to be made equitable under the circumstances of each of the Companies.

Sir J. BRUNNER: I think it is obvious that a change in the phraseology is required.

The CHAIRMAN: You do not object to the change we indicated as to the division of capital?

Mr. POPE thought it would be fair. The scheme was one to be shared in equal proportions by each Company; and it seemed to him that an equal contribution was the proper and fair way of dealing with it. He did not object to this; nor did he, in the case of the New River Company, object to the exclusion of their incomes as the contributing factor. The exception of the income of the New River Company derived from real or leasehold estate was just and equitable. The Companies did not take strong exception to the financial provisions of the decision of the Committee. If they decided that the debenture stock should be redeemable at par in 25 years, the Companies would not refuse to accept the decision. The Committee had declared that, in the event of the purchase of the water undertakings by a public Corporation or Trust, no additional value should be deemed to have accrued by reason of the supply of water secured under the Bill. The Companies would ask the Committee to add that no diminished value should be held to have taken place; because he thought they would be able to show that, under the operation of the sinking-fund, unless it was very carefully guarded, it would be quite possible for the actual value to diminish, by reason of the Companies being compelled to subscribe to the fund without having any corresponding earnings.

The CHAIRMAN: These words were an introduction of my own, explaining—rather generally than legislatively—the meaning attached to the clause in the Southwark and Vauxhall Act.

Mr. POPE: Quite so.

Sir J. BRUNNER: If you are determined that consideration should be given to this point of diminished value, will you not consider whether we should not insert clauses compelling the Companies to maintain the works?

Mr. POPE: There is, I think, a clause compelling the Companies to maintain their works.

Sir J. BRUNNER: I mean maintain the works at their original value, as to repairs and so on.

Mr. POPE: We will consider that, if the Committee suggest it as an alternative.

Sir J. BRUNNER: I only wanted to put it before your mind.

Mr. POPE said it therefore came to this, that the Companies had resolved, subject to the decision of the Committee, which had not yet been given upon various points that were left open for further consideration and evidence, to proceed with the Staines Reservoirs Bill. This seemed to him the most convenient course, and one likely to save everybody's time—including that of the Committee. Then, when they had ascertained what the Staines Reservoirs Bill would really give them, he should be prepared to make a statement to the Committee as to the New River Company, and to point out what portions of their Bill would be rendered unnecessary by this measure, of which they would then know the shape. In all probability, it would get rid of a good deal of the contentious matter from the New River Company's Bill, and, therefore, ultimately save a great deal of the time of the Committee. The proposition he ventured to submit was that the Committee should proceed with the Staines Reservoirs Bill, and discuss the clauses upon the basis of this arrangement.

The CHAIRMAN: Have you any clauses?

Mr. POPE: We have not prepared clauses, because we did not know the decision of the Committee. As to the matters upon which we are agreed, there will be no difficulty with reference to clauses; but on the two vital questions, of restriction of quantity and size of reservoirs, we must know your decision before we can prepare clauses.

The CHAIRMAN remarked that all there was to discuss was practically the size of the reservoirs, the quantity of water which was to be let in and taken out, the difference between "conduit" and "pipes," the rent for the river, and the sinking-fund clause.

Mr. POPE said there was also the Grand Junction question to consider, which was a separate matter.

The CHAIRMAN said the Committee felt that this, of all the Companies, was the one with the least storage and most available supply at the present moment; and in granting the powers sought under the Bill, they considered storage as of considerable importance to the consumers of the water. The Grand Junction Company, according to their own calculation, were in a position for some time to come to take nearly all their water from their present sources of supply, where they had a minimum of storage. The Committee thought that at least a portion of the supply to their consumers should come from stored water.

Mr. POPE said the Committee meant that the Company's surplus should pass into the reservoirs to be used as stored water.

The CHAIRMAN said the Company's daily service averaged about 19 million gallons; and they had the power of taking 24½ million gallons. Their ratio of increase had not been so great as the other Companies'; therefore he considered that a portion of the 19 million gallons required for the daily supply should be stored water. Of course, the power to draw the 24½ million gallons would be left in reserve.

Mr. POPE said the Companies' Engineer would state how far this could be done practically.

Mr. *R. E. Middleton*, M.Inst.C.E., the Engineer to the promoters, was then recalled and further examined by Mr. POPE. He said that any reduction in the size of the proposed reservoirs would make the cost larger per million gallons of water stored. To deal with the reservoirs separately, as a small scheme, would raise the cost by £30 per million gallons. The two reservoirs separately would cost £532,000; and the two together, £435,000. There was nearly £100,000 difference in the expense. With regard to the question of how far the minimum flow of water over Bell Weir could be increased with two reservoirs with a diminished outflow, a very small increase in the limit at Bell Weir meant a very large increase in the capacity of the reservoir. The balance of the scheme was the calculation of the size of the reservoir with the proposed flow over Bell Weir. It would destroy the balance of the scheme to make any alteration in the size of the reservoir. In the proposed scheme, the flow over Bell Weir had been increased to 265 million gallons, in order to get rid of any difficulty with the Southwark and Vauxhall Company, who drew their water from below Bell Weir. To carry the water from the new reservoirs in pipes would be much more costly than to use an open conduit, and, besides, the latter would aërate the water better. The total increased cost, with pumping power, would be £226,000.

The CHAIRMAN: Seeing that the water from Thirlmere to Manchester goes underground for a very long distance, and also the water from Vyrnwy to Liverpool, you would not suggest that aëration of the water in the present scheme for four or five hours is a very important matter, would you?

Witness: I think it is a very important matter, when coupled with the difference in cost.

In further examination, witness stated that the necessity for pumping would come from the difference in friction between an open conduit and a closed pipe. With regard to the limitation of the power to take water out of the Thames to 80 million gallons a day, and the discharge from the reservoirs, he considered that the limit of supply would be insufficient for the small term laid down—viz., ten years after the works were built, or fifteen years from now. The object of making two reservoirs was that one would be able to subside while the water was being drawn from the other. With regard to the suggestion as to drawing water from the conduit, he deprecated keeping the water in the reservoirs in a constant state of boil, by taking all the water through them. They wanted to avoid, as far as possible, putting into the reservoirs water that was in a state of flood; but if the reservoirs were beginning to get empty, the Companies would be bound to go straight to the Thames for anything they could get. The intention was at present to put 55 million gallons a day into the reservoirs. Unless they increased the size of the conduits leading down to the pumping-station, they could not put in very much more.

Witness having been cross-examined as to the flow of the Thames in dry seasons, and the details of the construction of the conduit, he submitted that the interests of the Thames Conservators would not be injured, and that, for many reasons, an open conduit would be more advantageous than underground pipes. He admitted that he had never personally had to do with the cleaning out of reservoirs which had been in use for five years. He had not seen mud at the bottom of reservoirs in an offensive condition.

Mr. *Walter Hunter* was then recalled, and examined by Mr. POPE as to the suggestion of the Committee that the Grand Junction Company should be bound to take a certain quantity of water from the reservoirs. He said it would be putting the Company to unnecessary expense to require them to pump really excellent water into storage reservoirs simply for the purpose of taking it out again. Their design in making these works was to allow the water when it was in good condition to flow straight down to their works, and to put a certain amount of water into store when they had it available. If they were compelled to take water constantly out of the reservoirs, he was afraid it might tend to some extent to deplete the provision of which they hoped to avail themselves only in periods of drought and flood. When water was coming down the river in the ordinary way—good, bright, sparkling water—then he thought it was quite as good to take it immediately into the works, and put it into the filter-beds, as if it had been stored for any time in reservoirs. Their present method of filtration enabled them to deal even with turbid water.

Some conversation then took place between the Committee and the Counsel as to the terms of the sinking-fund clause; and it was ultimately decided that the Companies should submit a draft clause at the next sitting.

The Committee cleared the room, and remained in private consultation for some time. On the re-admission of the public,

The CHAIRMAN, in announcing the decision of the Committee on the points submitted to them, said they had considered the evidence, and they proposed that the two reservoirs, 1 and 1a, should be part of the scheme; that the quantity of water to be pumped out of the Thames should be 100,000,000 gallons daily; that the total supply to be taken either from the conduits or from the reservoir, flowing down the conduit, instead of 45,000,000 gallons, which was proposed by Counsel, should be limited to 35,000,000 gallons daily, with power of going to the Local Government Board for an extra 10,000,000 gallons in case of necessity; and that the quantity of water flowing over Bell Weir should not be less than 275,000,000 gallons, or the corresponding quantity at Penton Hook. In the case of the Grand Junction Company, the Committee asked for a definite stipulation as to the quantity. With regard to pipes, the improvements in conduits was so considerable that the Committee did not ask for pipes to be substituted for the open conduits proposed in the Bill.

The proceedings were then adjourned till Monday (yesterday).

The Reigate Corporation and the East Surrey Water Bill.—The House of Commons Committee on Standing Orders gave their decision last Tuesday in regard to the petition of the Reigate Corporation to be heard against the Bill which the East Surrey Water Company are promoting. The petition presented by the Corporation (see *ante*, p. 1340) was found by the Examiners not to comply with the Standing Orders, inasmuch as it had not been lodged within the limit of time required. In consequence of this finding, the Corporation presented another petition to the Standing Orders Committee, asking that the Orders in respect to the time-limit might be dispensed with. To this, it is understood, the promoters took exception, on the ground that the Corporation had no legitimate excuse for not having deposited their petition by the proper time. The decision of the Committee was that the Orders should not be dispensed with, the effect of which is that the Corporation will not be heard in opposition to the measure.

Brighton Corporation (Water) Bill.—The Bill promoted by the Brighton Corporation for the purchase of the Shoreham and District Water-Works came last Tuesday before a Select Committee of the House of Lords, under the presidency of Earl Belmore. Petitions in opposition to the Bill had been lodged by the Hove Urban District Council and also by the Aldrington Water Company; but Counsel for the promoters (Mr. Pember, Q.C., Mr. Worsley Taylor, Q.C., and Mr. Claude Baggalley) successfully disputed the *locus standi* of the latter. For the promoters, evidence was given by Alderman Reeves, J.P., Mr. Johnstone, the Water Engineer of the Corporation, Mr. C. Hawksley, and Mr. W. B. Bryan, to the effect that it was desirable, in view of future requirements, that Brighton should acquire some additional source of water supply; and that by taking over the Shoreham works they would have an immediate excess of water after supplying the Company's district. The cross-examination of witnesses by Mr. Balfour Browne, Q.C., and Mr. Moon was directed to bringing out the fact that the profit drawn from Hove consumers went to reduce the rates in Brighton; and it was suggested that clauses remedying this should be inserted in the Bill. It was urged for the promoters in reply, that Brighton had borne all the risk of the undertaking, and that the profit for 23 years had not averaged 1 per cent. a year on the capital invested. On the following day, the case for the promoters was closed; and Mr. Balfour Browne, on behalf of the Hove Urban Council, suggested that Hove should be authorized to purchase the plant in its district, and should be bound to take water in bulk from the Corporation for 20 years. Mr. Worsley Taylor briefly replied. After a few minutes' deliberation in private, the Chairman announced that the Committee were of opinion that the Bill might go on without conditions. The Bill was subsequently reported.

Ashford Water Supply.—Mr. G. W. Wilcocks, on behalf of the Local Government Board, has just held an inquiry at Ashford, Kent, in respect of the application of the Ashford District Council for powers to borrow £2720 for constructing a new reservoir at the water-works. The Surveyor (Mr. W. Terrill) said it was proposed to erect a new reservoir of 280,000 gallons capacity, and when full the water in it would be 18 inches higher than it was in the present reservoir, which only held sufficient water for four hours' minimum consumption for about 7000 people who were supplied from it. Besides the reservoir, it was proposed to erect a water-tower and tank capable of holding 2500 gallons. This would be 38 feet above the top water in the reservoir, and would be used for supplying the cisterns in the roofs of the houses in the upper part of Ashford. The Inspector, who visited the works and the site of the proposed new reservoir, said his report would be made at once to the Local Government Board.

LEGAL INTELLIGENCE.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Tuesday, June 23.

(*Before the* MASTER OF THE ROLLS *and Lords Justices* KAY *and* A. L. SMITH.)

The Incandescent Gas-Light Company, Limited, v. The De Mare Incandescent Gas-Light System, Limited.

Mr. BOUSFIELD to-day resumed his argument on this appeal. He commenced by quoting some passages from the judgment of Mr. Justice Wills in the case against the Sunlight Company, in which he had decided against the contention put forward by the plaintiffs' Counsel, that the specification included any mantle made of oxides of the rare metals which would give light, and held that the inventor must be limited to what he had claimed. He (Mr. Bousfield) argued that, applying the same principle to the present case, the defendants could not be held to have infringed the patent, seeing that they had omitted lanthanum altogether, while it was plainly considered by the patentee to be essential. He also pointed out that, on the construction sought to be put on the specification by the plaintiffs, the words "and treated as set forth" had practically to be struck out. He then went on to explain that, although erbia was found in ytterite earth, it was only one of twenty or thirty constituents which entered into it; and it could not therefore be considered an equivalent for it. Later on in his argument—after citing the case of *Heath v. Unwin*—he reverted to the question of erbia and the knowledge of its properties at the date of the patent. He pointed out that Dr. Welsbach, in a subsequent patent, referred to erbia as a substance which was useful in producing a greenish light; and he spoke of having acquired this knowledge subsequently. Learned Counsel proceeded to quote passages from the evidence in illustration of the points he had put in his argument.

The MASTER of the ROLLS remarked that, if he had been trying the case, he should have over-ruled about two thousand of the questions as irrelevant.

Mr. BOUSFIELD replied that, in his view, it was of the greatest importance to show what were known equivalents to the substances mentioned in the specification at the time of the patent. The patentee was entitled to the substances named, and their known equivalents at the time; but he was not entitled to other things which later discoveries had shown might be substituted. He concluded by saying that his main contention was that the omission of lanthana prevented the defendants' article being an infringement, especially coupled with the fact that the ammonia process was not followed. From the point of view of the public, it was of the highest importance that a meaning should be put upon the specification, and that people should be in a position to know what they could do and what they could not, without infringing the patent. This was none the less important from the fact that the plaintiffs themselves were now using neither zirconium nor lanthanum, but were making mantles of substances quite different from those mentioned in this patent.

Mr. ROGER WALLACE followed on the same side, but was only able to proceed a short way before the time arrived for adjournment.

Wednesday, June 24.

Mr. WALLACE continued his argument this morning, and read a few passages from the evidence to show that, at the time of the patent, erbia was not a known equivalent for lanthanum or ytterite earth, or that mantles could be made of substantially one oxide, instead of the combination described by Welsbach. He then quoted from the judgment of Lord Westbury in the case of *Spencer v. Jack*, to show that, when one essential part of an invention was omitted, there was no infringement.

Mr. MOULTON then commenced his address on behalf of the respondents. He said it was now settled law that the knowledge of the time must be looked at in construing a specification. It was proved in this case that the whole question of lighting by incandescence with the aid of gas was revolutionized by Welsbach's invention.

Lord Justice KAY asked if any attempt had been made prior to this invention to use a mantle for incandescent lighting.

Mr. MOULTON said the nearest approach to it was a kind of basket, but that was a total failure, owing to its fragility. The success of Welsbach was due to the springiness of the mantle owing to its mode of construction.

Lord Justice KAY said it appeared then that the substance of the invention was the mode of constructing the mantle.

Mr. MOULTON said that was so; but the invention would have been of no use unless the inventor had given the right materials from which the mantles should be made. He discovered the suitability of the rare earths for this purpose; and these substances (which were formerly only produced in very small quantities) were now manufactured by tons—the whole world being ransacked for the materials from which to extract them. This was neither a chemical, nor a mechanical patent exactly; it was a patent for an apparatus, and the mode of making the apparatus. Erbium was included under the term ytterite earth.

Lord Justice KAY pointed out that, according to the patent, the oxide of yttrium might be omitted altogether.

Mr. MOULTON said he admitted that. Zirconia was the least rare of the rare earths; and, if it were used in combination with any of the other rare earths, he contended that the substance of the plaintiffs' invention was taken, although the lanthanum was omitted.

Lord Justice KAY asked if he contended that the use of zirconia alone would be an infringement.

Mr. MOULTON said that would be a question of evidence; and in this case the evidence had not been directed to that point.

The MASTER of the ROLLS said the principal part of the invention seemed to be the making of the mantle; and to be an infringement, the defendants must make their mantle in very much the same way.

Mr. MOULTON said that was so. He then went on to describe the method of preparation.

The MASTER of the ROLLS said it contemplated the use of both zirconium and lanthanum.

Mr. MOULTON submitted that erbia was an equivalent for lanthana. According to Sir Henry Roscoe's evidence, all the rare earths had the three properties of (1) forming soluble nitrate; (2) of decomposing under heat, and leaving the oxides; and (3) of giving incandescence. He therefore contended that they were all equivalents for each other.

Lord Justice KAY said the whole question seemed to be whether, leaving out lanthanum, the defendants still took the substantial part of the patent.

Mr. MOULTON said that was exactly how he put it, and how it was dealt with by the learned Judge. It was simply a question for the jury. He contended that the patent included the whole of the rare earths—not in terms, but implied as equivalents.

The MASTER of the ROLLS asked if there were not any document which stated what the defendants intended to do.

Mr. BOUSFIELD said there was no question that the defendants proposed to use zirconium and erbium.

Mr. MOULTON said he might go on for a long time; but it would be only repeating the same argument. He relied on the words of Lord Cairns in the case of *Clark v. Adie*.

Mr. BOUSFIELD, in reply to the Master of the Rolls, said the defendants had a patent—not for the materials employed, but for a certain form of burner or appliance to be used with a batswing burner. They proposed to make and sell such burners, fitted with an incandescent burner, which did not infringe the plaintiffs' patent. They had been advised that the combination of zirconia and erbia would not infringe; but if it were held that it was an infringement, they would have to take something else, because it had been held by Mr. Justice Wills, in the Sunlight case, that the plaintiffs had not a monopoly of incandescence. The plaintiffs argued before Mr. Justice Wills that a mantle of zirconia alone would infringe; but the learned Judge held against them. He (Mr. Bousfield) contended that the question of infringement must be decided by the construction of the specification—not by inquiring whether the alleged infringement gave practically the same result.

The MASTER of the ROLLS, in delivering judgment, said: The first question in this case seems to be whether Mr. Justice Wills has properly construed the plaintiffs' specification; and the second is whether, if he has properly construed it, he has been wrong in the decision of fact at which he has arrived. Now, his construction of the specification is as follows: "It seems to me now possible to understand exactly what the patentee claims. It is not the prescription, apart from the rest of the process. It is not the construction of the skeleton, or, as it has been aptly termed, a simulacrum of the vegetable fabric—in any oxides—or in any oxides which will give good and durable incandescence (a claim which would certainly vitiate the patent), but it is the combination of the various essential elements in the process described, the manufacture of the hood out of the substances mentioned by the patentee (no doubt because he had ascertained that they would answer) by the means of impregnation with the blends of salts within the descriptions and proportions indicated by the specification, including, of course, all such variations," and so on. Now, is that wrong? I cannot say that it is. It seems to me that it is a right description of what the patentee has claimed. Now what the patentee has claimed, it seems to me, among other things, as part of the process, is this. He has no doubt claimed the use of this oxide of lanthanum. He claimed this, because he says: "The proportions in which the substances are compounded may be varied within certain limits. I have found the following proportions very suitable: 60 per cent. zirconia or oxide of zirconium; 20 per cent. oxide of lanthanum; 20 per cent. oxide of yttrium. The oxide of yttrium may be dispensed with; the composition being then: 50 per cent. zirconia; and 50 per cent. oxide of lanthanum. Instead of using the oxide of yttrium—that is not lanthanum at all—"ytterite earth, and instead of oxide of lanthanum, cerite earth," and so on, "may be employed." Now, when he comes to the claim, he says: "I claim the manufacture substantially as herein described, of an illuminant appliance for gas and other burners, consisting of a cap or hood made of fabric impregnated with the substances mentioned and treated as set forth." Therefore, I have no doubt myself—and I think Mr. Justice Wills says the same—that he did claim as among the substances which were to produce what he says he intended to produce, lanthanum. But he has claimed it as part of a very long process. He has claimed that as a part of it; and he claimed the whole process including that. Now as to infringement. In order to see whether there has been an infringement, it seems to me the Judge has applied (and we ought to apply) the rule, which is applicable to this case, laid down by Lord Cairns in *Clark v. Adie*. He says there are different modes in which the question of infringement may be treated. The first is too easy to make it necessary to consider it; but the second mode would be one which might occasion more difficulty. It is the "second" one in this case; it is the second one which raises more difficulty, or which raises some difficulty, and which has given power therefore of arguing the present case for three days. It is the difficulty that is raised by the statement that "the infringer might not take the whole of the instrument"—that is, in this case, the whole of the matter which the patentee here describes—"but he might take a certain number of parts of the thing described; he might make an instrument"—here he might make whatever he calls it—"which in many respects would resemble the patented instrument, but would not resemble it in all its parts." Now, to apply that case here, he has not taken the whole of the compound; but he has taken something which resembles the compound, but does not resemble it in all its parts. "And there the question will be either for the jury or for any tribunal judging the facts of the case (because it is a question of fact), whether that which was done by the alleged infringer amounted to a colourable departure from the thing patented, and whether in what he had done he had not really taken and adopted the substance of the invention. It may well be that, if the thing patented consisted of twelve different steps"—here it is of twelve different things compounded—"the infringer who took eight or nine might be held by the tribunal judging of the patent to have taken, in substance, the pith and marrow of the invention, although there were one, two, three, four, or five steps which he had not actually taken and represented in his machine." That is the rule which we are to apply; that is the law to be gathered from the preceding case—a very authoritative case. That is the only use of quoting a case. It is of no use to quote a case as was quoted this morning, and say that somebody else in some other case had held that there was an infringement or that there was not. That has nothing to do with it. There is a rule of construction laid down—that is, of construing and dealing with evidence; and what we have to ask ourselves is, "Has Mr. Justice Wills acted upon that rule?" In his judgment he said, as to the first point which I have taken: "His specification [that is, the patentee's] claims the whole process by which he arrived at that result. Out of it, the defendants take [now these are the parts that he says are taken] the impregnation of the fabric by blends of salts of zirconia and the rare earths, and the reduction of these to anhydrous oxides forming the simulacrum of the fabric. I am satisfied by the evidence that it is this mode of getting blends of the specified oxides into the shape of the fabric out of which the hood has been made, that has rendered the process of any use; and that a mere variation of prescription—extending even to the omission of lanthana—is of very trifling consequence in comparison." That is, he holds, as a matter of fact, that Mr. De Mare (for he is the person who has advised the defendant Company to use what they are threatening to use) has taken all the steps of the plaintiffs' compound except lanthana. The plaintiffs have claimed lanthana as part of the compound; the defendants have taken all the steps except lanthana, which they have left out. Whether the patentee has put in anything else instead of, or as an equivalent for, it seems to me to be immaterial; he has left it out. Now comes the Judge and says: "Upon the evidence, I am satisfied that leaving that out is leaving out not a material part of it; and, therefore, according to the rule laid down by Lord Cairns, the defendants by leaving that out, have not escaped from the fault of infringing the plaintiffs' claim. One may say that one differs from the Judge as to the rectitude of his view, that leaving out lanthana is immaterial. If that were made out to our satisfaction, then his judgment would be wrong; but I have heard nothing which convinces me that, in saying that and in acting upon what he said, he was going wrong on the question of fact. And if it cannot be proved now that he was wrong on the question of fact—that is, his inference of fact, the inference of fact being the fact itself—the defendants must fail in their appeal. They have failed in convincing me that Mr. Justice Wills was wrong upon that point; and if he was right, he acted on a right view. He has found a right fact; and, therefore, the appeal must be dismissed.

Lord Justice KAY: The only question brought before us by this appeal is whether the defendants in what they propose to do would infringe the patent of the plaintiffs. Of course, it is important in the first place to ascertain what the patent of the plaintiffs was, and what it included, and what was the extent and scope of it; and, in order to ascertain this, it is important to know what was, at the time when this patent was taken out, the state of knowledge on the subject. I think all may be described in a very few words. Up to the time when this patent was taken out in 1885, it was perfectly well known that certain compounds—oxides of what are called some of the rare earths—when put into immediate contact with a gas-flame would enormously increase the light; and we are told the mode in which this could be done. A great deal of the heat of the gas-flame which was scarcely visible to the eye was, by rendering the substances incandescent, given off to the eye by the incandescent substance in the form of light rays. Therefore more light rays came from the incandescent substance than from the gas-flame without it. I am not scientific enough to know whether that is a true description or not; but, upon the evidence before us, we must assume that it is. Indeed, I believe (as far as I can make out) both sides pretty well agree in this description of the effect of these incandescent substances, or the substances which may be raised to a state of incandescence upon an ordinary gas-burner. The problem was how to apply it; and the patent of the plaintiffs is a patent for an apparatus for applying these substances to produce that result. Now, it was known for a long time—I remember it myself when I was quite a boy—that the oxy-hydrogen flame made to bear upon a solid piece of lime caused that lime, when raised to a state of incandescence, to give off a much brighter light than could be obtained in the flame itself. But that was not a process applicable to ordinary gas-flames—at any rate in the same way, and with the same result, which the plaintiff's patent enables people to arrive at it. The problem which the patentee had to solve was this: It being known that certain oxides will in this way enormously increase (when in a state of incandescence) the light given off by a gas-flame, how are they to be applied? What is the mode of applying them? The patentee set himself to solve this problem; and I understand that, up to the time when this patent was taken out, nothing like the mode of appliance which the patentee invented had ever been used. In that sense it is what is called a "pioneer" patent. Somebody has adopted the word "pioneer;" but what is meant is that it was the very first time that this mode of applying this substance to a gas-flame, or any practical mode of doing it, had been discovered. The discoverer was Welsbach, who practically is the person who took out this patent. Now, he describes a somewhat elaborate apparatus. He uses the word "appliance." It is a very good word; but I choose the word "apparatus" as being for the purpose an entirely neutral word. To put it as briefly as I can, in my own language, it is this: He takes a cotton fabric. The fabric he particularly describes is a piece like this, which is a sort of tube of open-worked woven cotton. He subjects it to a solution of the oxides of certain rare metals, which he describes. He gets them in this way, by using them in a soluble state, to permeate the whole substance of the cotton. Then he describes the plan of submitting the fabric to ammonia gas, the object of which is to get rid of the nitrate which made it soluble, and to turn it back into the condition of oxide. Then, when all this has been done, and the fabric has been made—when it has been in this way saturated with the solution, and when the solution has got back to the state of oxide, he finds the remarkable result, which nobody in the world ever knew of up to 1885, that the fabric may then be exposed to the heat of a gas-flame, which burns out the cotton completely—destroys the carbon, and leaves a fabric composed simply of the oxides, which he has in this way got to permeate the cotton; and those oxides in an extremely fragile formation may be exposed to an enormous amount of heat till they become heated to what is usually called a white heat, and in that state of incandescence

they give out a most powerful light—far more powerful than the gas-flame itself would give. That is my brief, and I dare say very imperfect, description of this invention. It is not an invention for using the salts producing incandescence. It is an invention for applying them to a gas-flame, and applying them in a way which nobody else dreamed of until this patent was taken out. The patentee claims not merely the solution of salts—that is far from what the learned Judge aptly describes as the prescription for saturating the cotton fibre; but he claims the whole thing. He claims the whole apparatus; and the words which he uses are these: "My invention relates to the manufacture of an illuminant appliance in the form of a cap or hood, to be rendered incandescent by gas and other burners so as to enhance their illuminating power." The claim is in these words: "The manufacture, substantially as herein described, of an illuminant appliance for gas and other burners, consisting of a cap or hood made of fabric impregnated with the substances mentioned and treated as set forth." Now, I will read one other passage from the judgment of the learned Judge, in addition to that which the Master of the Rolls has read, which expresses my opinion of the meaning of this patent quite perfectly. He says this: "There can be no doubt of the importance attached by Welsbach to the use of the oxide of lanthanum, which he clearly regards as a thing not to be omitted from what he claims; and he therefore enters upon the contest as to infringement heavily handicapped, as it were, by his own view as to the great importance of the use of lanthanum in his prescription. But for the reasons I have already given, I think the fact has no further weight, and leaves me free to exercise my own judgment in weighing this fact with others when dealing with the question of infringement. If the patent consisted of the mere prescription"—that is, the use of the salts that he gets in a soluble form, and the mode of saturating the cotton—"the omission of lanthanum and the variations of the proportions would, of course, prevent the defendants from being treated as infringers. But this is not a patent of that description. The claim is far wider; and the patentee is accordingly entitled to a larger measure of protection. 'It goes to the very root of the case,' says Lord Justice Bowen, speaking of infringement, 'to remember that this is, as it was described by one of the Counsel, a pioneer invention; and it is by the light of that, as it seems to me, that we ought to consider the question whether there have been variations or omissions and additions which prevent the machine complained of from being an infringement of the plaintiffs'.'" Then again, a little lower down, Mr. Justice Wills says: "Now what was the character of Welsbach's invention so far as result is concerned? It was undoubtedly a perfectly new result, and in every respect deserving the name of a 'pioneer' invention." Now, what was the state of knowledge (before I look at the rest of the patent) at the time this patent was taken out? I find this in the evidence of Sir Henry Roscoe: "Taking the knowledge of the specification and taking the common knowledge of the time"—that is, at the date of the specification—"with regard to these metals, would you have known that a compound made of erbia and zirconia could be used as a substitute for the compound mentioned in the specification? I should not have been able to tell that a mantle made of zirconia and erbia would have the same properties as one made according to the specification. It was known, of course, long before 1885 that erbia when placed in the bunsen flame did give out a bright incandescence. That, of course, was common knowledge at the time. And it was known that zirconia gave incandescence also." Then part of the patent was read to the witness; and his answer was: "I should not have known that a mixture of erbia and zirconia would have acted in a similar way to one of lanthanum and zirconium. As I have said, I knew then (or it was known then) that both zirconia and erbia did give a luminosity when brought into the flame." And again later on, the same witness was asked this: "Of all the mantles that are in use at the present time, have you ever known one that was not obtained by a solution of soluble salts of these refractory metals (metals yielding refractory oxides) which was burnt off in the way described by Welsbach?" He answered: "Well, I am afraid I could not give you an answer to so general a question as that. I do not think I am acquainted with the various mantles that have been made, and there are a number of them." He was then asked: "Was it known that these rare oxides would incandesce prior to the date of the 1885 specification?" He replied: "Yes, I have already said that I was in Bunsen's laboratory, and saw these experiments, which, in my opinion, led to Welsbach's discoveries or patents. It was known that these nitrates would decompose on heating, and leave the oxides." Now, I have read the patentee's description of the invention from the beginning of the specification and from the claim. Then he says: "For this purpose"—that is, for the purpose of making his illuminant appliance in the form of a cap or hood—"I employ a compound of oxide of lanthanum and zirconium, or of these with oxide of yttrium, which substances in a finely divided condition, when they are heated by a flame, give out a full, large, almost pure white light, without becoming volatilized or producing scale or ash, even after being kept incandescent for many hours." Then he gives the proportions that he finds very suitable of the three substances. Then he says: "The oxide of yttrium may be dispensed with"—leaving the composition simply 50 per cent. zirconia and 50 per cent. oxide of lanthanum. Then again he says: "Instead of using the oxide of ytterite earth, and instead of oxide of lanthanum, cerite earth containing no didymium, and but little cerium, may be employed." Then he gives, in detail, the manner in which this is to be applied to the cotton fabric which he intends to use; and he says that first of all he saturates the fabric with an aqueous solution of nitrate or acetate of the oxides. Now, we are told (and I accept it) that the oxides themselves are insoluble. To make them soluble, he has to get a nitrate or an acetate, first of all. That makes them soluble, and enables him to impregnate the cotton fabric with them. Then he has to get rid of the nitrates or acetic acid which is in them; and he says he does this by exposing the fabric to ammonia gas. He does not say why they should be exposed to ammonia gas; but he says: "The fabric is then exposed to ammonia gas, and when it is dried it is cut into strips and folded into plaits." By this means we are told that the effect of the application of ammonia gas is to get the fabric back into a state of oxide. Also, the evidence shows quite plainly that you may dispense with the use of ammonia gas, because the application of heat produces the same effects—it drives out the acids, and reduces the delicate substance that is left to the condition of oxide again. Not much stress was laid in the argument before us upon this part of the case. It was treated really as not an essential part of the process. Now then, as to the question of infringement. Taking the meaning of this specification to be as wide as the learned Judge says—the whole apparatus, and the mode of making this apparatus—the question is whether or not what the defendants have done is an infringement. First of all, I absolutely dissent from the sort of construction that has been put to us on behalf of the appellants. It really has been put to us that we ought to treat this patent as if it were a patent for the use of zirconia or the oxide of zirconium with the oxide of lanthanum, and that only; and as though the making of the cap or hood and the appliance of these oxides in this very remarkable and peculiar manner, had little or nothing to do with the patent. It was said: "This is a patent for the use of the oxide of lanthanum and the oxide of zirconium; and the patentee must be confined to his patent. You must limit it to that. He has claimed these two things; and if we can do without one of them, we are not infringing the patent." I entirely dissent from such an argument. That is not the patent at all. The patent is for the whole thing—for the peculiar mode of applying these oxides. Now let us see what the defendants have done. I will put it again in their own words. Their patentee has taken two substances. He has for one taken zirconia, which is exactly one of the things described in the plaintiffs' patent. He has taken, to begin with, a cotton fabric. He admits that the form of his cotton fabric, although it differs from that of the plaintiffs, has nothing to do with the matter at all. It is just as though, for the purpose of this question of infringement, he had taken the identical thing in form which the plaintiffs use. He has taken the cotton fabric. He has taken zirconia and erbia, and he has made them soluble. He has saturated his cotton fabric with the solution of these two substances, and has driven out the acids which made them soluble by the application of heat. He has therefore reduced his mantle to the condition of the oxides of these rare metals—or rare earths, as they are called—simply; and he has burnt away the cotton fabric which was the basis of them before heat was applied. He says: "I admit that I have taken everything in this patent which the plaintiffs have described. I have made my illuminant appliance precisely in the same way. I have made the basis of it a cotton fabric. I have used the solution. I have used the soluble form of these things. I have saturated the cotton with the soluble form. I have then reduced the saturated cotton. I have burnt out the cotton. I have expelled the ashes. I have left it in the form of oxides of these two substances. And yet I say, because I have not employed lanthanum, I have not infringed the patent." That is the whole question; and really it is a question that did not, I must say, deserve two days' argument. I think it could be stated in a very short time; and I should have thought the argument would have been very short. There can be no doubt about the meaning of the patent. The question is whether, because the defendants' patentee has left out lanthanum entirely, and put in no equivalent at all, he is or is not infringing. Now, what he has actually done is this: He has not satisfied himself by leaving out lanthanum, and using zirconia only; he has rather taken the alternative in the patent, which was zirconia, lanthana, and the oxide of yttrium. He has left out the oxide of lanthanum; and, instead of the oxide of yttrium, he has used erbia. Now, there is abundant evidence to show that erbia is one of the components of ytterite earth, and a large component of it; and it is one of the very things which, on the face of this patent, the patentee says may be used. [Lord Justice Kay then gave several references, to show that he had endeavoured to follow the argument as closely as possible and the evidence as it was presented to the Court.] Now then, as to erbia. Erbia, we are told, is very often a large component of ytterite earth; and ytterite earth is one of the things mentioned in the specification as a substance which may be used instead of the oxide of yttrium. They take erbia; and they use it and zirconia and certain other small ingredients which we have not heard much about, and which do not seem to have much to do with the matter. Then, they say: "We leave out lanthanum altogether; and we do everything you describe except using the ammonia. This we find we can do without, because heating produces the same effect. We use zirconia, we use erbia; but we do not use lanthanum. We say that, although nobody ever did apply any of these substances in this way until your patent was taken out, we have a right to make the very same appliance, leaving out the lanthanum, and using these other substances." The short point is, Is such a proceeding, in Lord Cairns's language, taking the substance of his patent or not? I quite agree with what has been read from the judgment of Mr. Justice Wills. He expressed it in words better than I can use. Here are a number of things described, the object of which is to produce this lamp, which will remain at a white heat for a long time without disintegrating, and will produce a very considerable light. A mode of doing this is described. Part—and an essential part—of it is keeping it in this solution. The defendants' patentee says: "I take your whole process—I make the very identical thing; but I alter the solution. I admit that my light cannot be as good as yours. You have given a description of that which will give the best light you can invent; but I do not care to do as much. I will be content with a smaller light; but, because I have left out lanthanum from the whole of this elaborate process, I say I do not infringe your patent." All I can say is, that I entirely disagree with such a contention. It seems to me the law is exactly the other way; that this is, in fact, taking all the steps of the process—taking the whole of this invention, but leaving out one of the ingredients. In short, the defendants are really trying to avail themselves of this ingenious invention of Welsbach's. They are trying how near to the invention they dare go, or can be allowed to go, so as to obtain the advantage of it without being open to the penalties to which an infringer is subject. I think that they have stepped over the line; and that they have taken, and intended to take, the substance and essence of this patent. Therefore, in my opinion, the decision of the learned Judge was quite right; and this appeal ought to be dismissed, with costs.

Lord Justice A. L. Smith: In as short a form as I can, I will state how this case strikes me. This was an action upon a patent for threats to

infringe the patent; and the claim is for an injunction to restrain the defendants from committing the infringement. The defendants, in answer to that action before Mr. Justice Wills, contested the validity of the patent, putting in all the defences which a person who is sued for the infringement of a patent usually puts forward. The case was tried out at very great length—lasting, I think, thirteen or fourteen days. Mr. Justice Wills gave judgment for the plaintiffs; holding that the patent, which was Welsbach's patent, was a good one. He also held that the defendants had infringed it. On appeal here, the sole question is whether or not the learned Judge was right in holding that the defendants had infringed the patent. Now the case was argued at first by the learned Counsel for the appellants (Mr. Bousfield); and he put it in this very short form when he raised the point before us. He said that, upon the true construction of this patent, as soon as it was found out that what the defendants were proposing to do was to use erbium and not lanthanum, the learned Judge should have held that there was no infringement of the plaintiffs' patent. That is the way in which Mr. Bousfield put his case. It is the shortest way in which he could state it; and in substance the case he has put before us on appeal is that, once it was found his clients were not going to use lanthanum (but were going to use erbium), the Judge ought to have non-suited. If this had been a patent claiming merely the use of zirconium and the use of lanthanum (it is really the oxides of those metals, but I call them zirconium and lanthanum), I should have thought that Mr. Bousfield's point was a good one; but, as I understand it, it is not a patent of this description. I understand if it were a patent for the use of two things together for the purpose of bringing out a result, it does not cover, as regards the public, the use of one alone without the other. If a man claims for the combined use of oil and vinegar, he cannot stop anyone from using oil alone, nor can he stop him from using vinegar alone. That is, of course, always assuming that the claim is a valid one for the use in combination of oil and vinegar. But when this case is examined, that is not this patent at all. The patent is not a patent simply for the use of zirconium and lanthanum—it is a far greater claim than that; and I will read just three lines of Mr. Justice Wills's judgment, because he most tersely states what in reality this patent is. He says: "Welsbach certainly discovered for the first time a method [I read in "or process"] by which a skeleton [that is what has been during the last two or three days called a mantle], frail but durable, of the resistant earthy oxides mentioned by him, could be produced, which would give practically a means of obtaining light by incandescence, which would surpass the economy of the best modes known of getting illumination from gas. His specification claims the whole process by which he arrived at this result." That, in very short and apt language, describes what this patent is for. I am not going to read it, because it is described there in a manner more accurate than I could do *vivâ voce* now; and I entirely agree with what Mr. Justice Wills said about it. The whole process is described—the making of the skeleton from beginning to end, bringing about this incandescence by means of the use of these rare earths in a mantle. That process being composed of many parts—not being limited, as it was argued, to zirconium and lanthanum, although he was going to use zirconium and lanthanum in his process—when one comes to the question as to whether this patent composed of many parts has been infringed, it is necessary to look and see what in reality the defendants' patentee has done, and what in reality he has taken from the plaintiffs. First of all, what is he doing as a matter of fact? It is impossible to nonsuit the plaintiffs here on this point—absolutely impossible; but, as a matter of fact, has the defendants' patentee by what he is doing been about to take what I think Lord Cairns called the "pith and marrow" of the matter, and what he also calls in *Clark v. Adie* taking the substance of what the plaintiffs' patentee has covered by his patent? That is a question of fact to be decided upon the evidence; and I must say it seems to me that the point which was taken by Mr. Bousfield upon which he launched this appeal—viz., that the learned Judge ought to have nonsuited the plaintiffs as soon as he found out that lanthanum was not to be used by the defendants—fails him. The fight has not been so much upon the evidence. The learned Judge has found that leaving out lanthanum, and doing what the defendants do, is in reality taking the substance of the plaintiffs' patent; and I see no reason to quarrel with him upon this point. The argument advanced by Mr. Bousfield has been that the "pith and marrow" of the patent is lanthanum used with zirconium. I do not read it in that way. There is a great deal more "pith and marrow" than the mere use of zirconium and lanthanum. Leaving out lanthanum and using erbium—I do not use that as an equivalent, for I do not know what the evidence is on that point, but I will take it that it is not, although it would come in under the ytterite earths—I take it that Mr. Justice Wills was right in holding as he did that the defendants, in taking what they did, took in substance all that was covered by the plaintiffs' patent.

The appeal was, therefore, dismissed, with costs.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

Monday, June 22.

(*Before Justices* CAVE *and* WILLS.)

Brighouse Corporation v. Elland Lower Edge Water Company.

This was an appeal from a decision of the Judge of the Halifax County Court, given on the 18th of May last (see *ante*, p. 1176), in favour of the plaintiffs, who sued the defendants for £41 odd for water supplied to them during 1894 and 1895. The defendants set up that the plaintiffs could only sue under the powers conferred by the Water-Works Clauses Acts, and that the summary remedy given in those Acts for recovery of water-rates, &c., was limited by Jarvis's Act to a period of six months. They therefore paid into Court a certain sum and denied liability as to the remainder—being the first six items in the claim. The County Court Judge held that the plaintiffs were entitled to recover the whole sum claimed; and he gave a verdict accordingly. It appeared that the plaintiff Corporation, who were constituted by Charter in 1893, comprised within their limits the district of Rastrick; and in 1889, the Rastrick Local Board took over the works of the Rastrick Water Company, who were then supplying the district as well as the defendant Company (who served the adjacent district of Elland Lower Edge) with water under an agreement at a certain price per 1000 gallons. This price was originally 2s.; but it was subsequently reduced to 1s.; and in 1893, on the incorporation of Brighouse, it was lowered in the borough to 8d. Defendants claimed, to be supplied on the same terms, while plaintiffs insisted on charging them 1s.; and the litigation arose out of this dispute.

Sir G. W. MORRISON appeared for the appellants; Mr. CHANNELL, for the respondents.

At the close of the arguments,

Justice CAVE, in giving judgment, said he was of opinion that the appeal must be dismissed. The plaintiffs had sold and delivered to the defendants a certain quantity of water, which it was not suggested that they had not power to do; nor that the defendants had not power to buy it. It followed that the plaintiffs were entitled to sue for the price, unless there was any statutory provision taking away that ordinary right at common law; and he could not find anything. The sections which had been referred to gave water companies certain rights and remedies of a summary nature which they would not otherwise have; but there was nothing to deprive them of the common law right of recovering from a purchaser the price of what they had sold.

Justice WILLS concurred.

The appeal was therefore dismissed, with costs.

BIRKDALE POLICE COURT—Thursday, June 25.

(*Before Dr.* G. B. BARRON, *Chairman, and a Bench of Magistrates.*)

The Quality of the Gas Supplied by the Southport Corporation.

The hearing of the summonses against the Southport Corporation for failing to supply to the township of Birkdale gas of the illuminating power and quality specified by the Southport Improvement Act, 1871, came again to-day before the Magistrates for decision. The previous proceedings in this matter have already been reported (see *ante*, pp. 987, 1176, 1408). There were three separate summonses, relating to the 5th, 7th, and 10th of February last.

Mr. HORRIDGE appeared for the prosecution, which was instituted by the Birkdale District Council; Mr. J. DAVIES WILLIAMS, the Town Clerk of Southport, defended.

Mr. HORRIDGE, at the outset of the proceedings, drew attention to the fact that a member of the Corporation occupied a seat on the Bench. He assumed that Alderman Nicholson, to whom he referred, was not going to take any part in the decision of the case.

Dr. BARRON: We have talked the matter over; and it is understood that Alderman Nicholson shall take no part in the matter.

Mr. HORRIDGE said he did not propose to open the case again at any length, because there was very little difference in the constitution of the Bench now to that on the former occasion. He would merely hand up a copy of the Act of Parliament under which the proceedings were taken, so as to refresh the memory of the Magistrates with regard to the section to which he referred on the last occasion. Before dealing with the case, he ought to put in two orders made since the last occasion by the Queen's Bench Division of the High Court of Justice. One was dated May 21 last. It was an order *nisi*, prohibiting the Bench from exercising jurisdiction. The other was dated June 25, dismissing the rule *nisi* with costs. Therefore the case now came before the Bench; the High Court having decided that they had jurisdiction. He then referred to section 35 of the Act, which provided for the illuminating power of the gas. This section was as follows: "The gas supplied by the Corporation shall be of such illuminating power as to produce, from an argand burner having 15 holes and a 7-inch chimney, or other approved burner and chimney or burners, consuming 5 cubic feet of gas per hour, a light equal in intensity to the light produced by 20 sperm candles of six in the pound, burning 120 grains per hour." Therefore the test was for 20-candle power under that section. Section 40 was the one under which they were proceeding. It said: "If the Local Board shall provide within the township a testing meter or meters, and other apparatus for testing the illuminating power of the gas within the township, they may, by an order or orders in writing, from time to time appoint some person, not being one of themselves, or some other officers or servants, to make experiments of the illuminating power of the gas by means of such testing-meters and other apparatus; but three hours' previous notice in writing shall be given to the Corporation of such intended experiment, and the Manager of the gas-works, or some duly authorized officer of the Corporation, shall have access to the place of testing. And if it shall at any time be proved to the satisfaction of any two justices, after hearing the parties, that the illuminating power of the gas did not, when so tested, as aforesaid, equal the illuminating power by this Act prescribed, the Corporation shall forfeit such sum, not exceeding £40, as the justices shall determine to be paid to the Local Board." This Act was passed in 1871; and ever since 1880, tests had been going on between the Birkdale Local Board and the Southport Corporation. On every occasion the argand burner, which was the one named in the section, was used. The Corporation of Southport objected to this burner. They said it ought to be a different one, because of the words "or other approved burner." He told the Bench at the last hearing of the case that it was impossible to give any other meaning to these words, except a burner approved by the parties. It was impossible to say what it meant in the abstract, because the question would become too indefinite. An opinion was obtained at the time from Mr. Michael, an eminent Counsel, who had since died; and after this opinion had been taken, the Corporation served a notice upon the Birkdale Local Board to produce a letter from the Town Clerk sent in 1889, suggesting that the mains in Birkdale were insufficient. However, Mr. Bellamy, who had charge of the gas in Birkdale, tested the pressure; and he was satisfied that the mains were sufficient.

The TOWN CLERK remarked that there was no question of pressure raised.

Mr. HORRIDGE said he referred to the matter because, in the last

day or two, notice had been served upon them to produce the letter in which the complaint was made. He was told by experts that the pressure had nothing to do with the illuminating power; and perhaps this was the reason why the point was not going to be pressed.

The TOWN CLERK again informed the Court that the question of pressure would not be raised that day. He did not propose to refer at all to the fact of the contracting of the mains.

Mr. HORRIDGE said that Mr. Bellamy had tested the gas; and he (Mr. Horridge) was bound to say that the illuminating power and pressure were two quite distinct questions. Of course, if they had a house or a church full of lights, they would not have sufficient power for all the lights; but if they had one full light, the question of the illuminating power could be decided irrespective of the pressure. He would now come to the actual facts of the testing. The Birkdale Urban District Council, on Jan. 7, 1896, passed the following resolution: "That experiments be made of the illuminating power of the gas within the township, by means of a testing-meter or other apparatus, and that notice of such intended experiments be given to the Southport Corporation; that in case the illuminating power of the gas does not reach the standard prescribed, steps be taken to recover the penalties imposed by the Southport Improvement Act of 1871, and that the Law Clerk be instructed to take such steps forthwith." It was also resolved that a Sub-Committee be appointed to assist the Law Clerk in the necessary proceedings. The Sub-Committee then passed a resolution appointing Mr. Bellamy, of Liverpool, and Mr. Isaac Carr, of Widnes, to test the illuminating power of the gas, through the testing-meter referred to; and that action of the Committee was confirmed by the Council. Mr. Bellamy and Mr. Carr were therefore appointed in pursuance of the Act of Parliament; and on Feb. 5 three hours' notice was served on the Corporation of their intention to make the tests. These took place in the presence of Mr. Booth, the Gas Engineer. They would remember that on the last occasion he explained how the tests were made—viz., with the Evans photometer prescribed by the Gas-Works Clauses Act of 1871. At these three tests, the Gas Engineer made only one complaint; and the tests were accordingly repeated. The three tests referred to in the summonses were therefore apparently satisfactorily performed; and no complaint was made until the defendants heard of the summonses. When the case was last before the Bench, it was adjourned on a certain undertaking; and he could not help telling the Magistrates that he was greatly surprised to think that this promise had not been fulfilled. He would have to ask the Magistrates to make an order in regard to the matter if they decided to convict. He understood, when the undertaking was given on April 3 by the Town Clerk, on behalf of the Corporation, that the 25 guineas fixed for the cost of the adjournment would be at once paid.

Dr. BARRON said it was generally understood by the Bench that the amount would be paid immediately.

The TOWN CLERK said he did not understand that was so.

Mr. *Cross* was then called by Mr. HORRIDGE, and proved the service of the notice on the Corporation, as required by the Statute, on Feb. 5.

Mr. *Bellamy* said that he had charge of the gas department of the Corporation of Liverpool. He had had considerable experience in testing the quality of gas. He had tested the Birkdale gas during the last ten years, and could give the Town Clerk any of the results. On no occasion had the statutory test been quite reached. On Feb. 5, he, in pursuance of the appointment from the Birkdale Urban District Council, attended the testing-station at Birkdale. The photometer which was put up at the station was an Evans photometer described in the schedule attached to the Gas-Works Clauses Amendment Act of 1871. He knew the section of the schedule of the Act of Parliament referred to; and the photometer at Birkdale fully complied with the requirements of that schedule. He was also familiar with the directions as to testing contained in the schedule. The tests were carried out entirely in accordance with the Act of 1871. The burner used was the 15-hole argand of the period of 1871, which was suitable for 20-candle gas. He used a 7 inch by 2 inch chimney, which was commonly known as a 7-inch chimney. Mr. Carr and Mr. Booth were with him at the time. He took the test about ten minutes past six on Feb. 5. Three tests were made on this date; and one was rejected because the sperm consumption was not satisfactory. Mr. Booth complained; and witness made a separate test, when Mr. Booth expressed his approval. The result of the first test was 16·25 candles; and of the second, 15·93 candles.

The TOWN CLERK inquired if Mr. Horridge was going to take the three summonses together.

Mr. HORRIDGE: I think I had better not.

The TOWN CLERK: The only thing is that we took certain measures on Feb. 10 that we were not in a position to take on Feb. 5. I have evidence relating to the former, which I have not got as regards the latter date.

Mr. HORRIDGE: I will take my evidence with regard to Feb. 18, if it will assist the Corporation.

Mr. *Bellamy* (continuing) said he took the tests on Feb. 18, commencing shortly after six o'clock. He took two tests; and no complaint was made about either by Mr. Booth. The first test showed 16·24 candles; and the second, 16·62 candles. He might mention that there was a very slight error made in these tests; and he noticed that they were subsequently corrected. He thought the calculations for temperature and barometric pressure were divided by 1009, not 1007, so that it affected the second place of decimal. The accurate tests should have been 16·21 instead of 16·24 candles, and 16·58 instead of 16·62 candles; being a little lower than what he took.

The CHAIRMAN: Who owns the pipes?

Mr. HORRIDGE: The District Council.

The CHAIRMAN: Who laid them?

Mr. HORRIDGE: The Birkdale Council.

The CHAIRMAN: And they were agreed to at the time by the Southport Corporation?

Mr. HORRIDGE: They rent them practically from the District Council under the Act of Parliament. The mains and everything are owned by the Birkdale Council.

The CHAIRMAN said he wanted to get at the fact whether the capacity of the pipes was regulated by the Corporation or the District Council.

Mr. HORRIDGE said the Corporation had no voice as regarded the pipes.

The TOWN CLERK, proceeding to cross-examine witness, asked if it would not be the proper thing to add together the results of the tests on Feb. 18, and divide by two. This would, he said, give about 16·39 candles, taking the average of the two tests.

Witness: Quite so. I gave the average in my report in that way.

Mr. HORRIDGE remarked that the Act of Parliament prescribed how that was to be done.

The TOWN CLERK: What I want to ask Mr. Bellamy is whether, for the purposes of this case, it would not be a fair thing to add the results of the tests together, and divide by two?

Witness: I think there is no objection to that at all.

There is no difficulty in accounting for the difference in the results obtained by you and those obtained by us, because we use different burners?—Quite so.

I think I have got a table here which you handed in to us in 1888. In this table you gave the final results of a large number of tests you made, with a view of properly comparing the burner you use and the one we employ?—Yes, that is so.

According to the table, the difference would be, in your opinion, somewhere about 4 candles?—Very nearly.

So that if we were entitled (which is the question) to use the burner which we employed in testing, and if you had used it on this date, you would have obtained a record up to the statutory requirements?—Unquestionably.

Do you agree with me that the result obtained from gas combustion depends upon the burner?—Entirely.

Let us see to what extent it has been found by experiment that that is the case. I think you have been good enough to enlighten the public on this very point?—Yes, in various ways.

In a pamphlet you have written, you say that one burner may develop ten times as much as another with the same consumption of gas?—Yes, that is so.

Then you state what is fairly recognized in the gas world—that gases of different illuminating values require different burners for their economic combustion; a burner suitable for 16-candle gas being most wasteful when used with the gas supplied in Liverpool, and when adopted often affords an explanation of the user complaining of dirty and smoky gas?—True.

If we supplied 20-candle power gas, the reasoning here would apply to our case?—I do not follow that, because it is always competent for the consumer to adopt the most suitable form of burner for the gas he is using.

You go on to say: "As burners of this type are most commonly manufactured for all purposes, it frequently happen there is great difficulty in obtaining a burner suitable for gas of high illuminating power; and consequently the richer gas, instead of being an advantage to the consumer, often becomes a positive source of trouble and loss?"—That is clearly so. I was urging the consumer, in this case, to take advantage of the rich gas he was obtaining by using a proper form of burner.

The Gas Committee of Liverpool went to a considerable amount of trouble last year to examine into this question of the differences in gas?—They did.

You are aware, as a matter of fact, that out of the many hundreds of corporations and companies owning gas-works in this country, Liverpool and Southport are the only two under a statutory obligation to supply 20-candle gas?—I will not admit there are not other cases.

The tests that you made on this occasion gave widely different results, according to the burners? We are not speaking now of a consumer's burner, but of those used for testing.—The object of the Liverpool Corporation was to obtain the value of the gas supplied in various large towns, when measured with their own burner; and in addition to that, we tested in each case with the statutory burner.

You say here the average of the tests with the standard batswing burner was 16·39 candles; and with the ordinary fishtail, 10·90 candles. Therefore the average loss of light by the user of the ordinary fishtail burner would appear to amount to 34 per cent., which is certainly heavy?—It is.

Suppose that we had no Act of Parliament, and were under no obligation to supply gas of any given illuminating power, and suppose also that you had as a datum that the gas was somewhere about 20 candles, would you have selected the burner you actually used on Feb. 18 for testing the gas?—You ask me to suppose an impossible condition of things. For instance, if you had had no Act, I should not have tested the gas.

Mr. HORRIDGE said he objected to the form of cross-examination, which was absolutely immaterial, because the Bench were dealing with a case where there was an Act of Parliament.

The TOWN CLERK: Very well. I will not suppose anything, but I will ask Mr. Bellamy if, speaking as a scientific man, he considers that the argand burner which he used on the 18th of February is suitable for developing the light of our gas.

Mr. HORRIDGE said the question was not relative. He ventured to submit that the Bench could not consider the question whether it was a proper or improper burner, as long as the Act of Parliament prescribed it.

The burner was here produced.

The TOWN CLERK said that it was marked 18 candles. He believed there were burners for 14, 16, or 18 candles.

Witness: Certainly.

A burner which is suitable for 14-candle gas is not suitable for 16-candles?—They can make an advance of two candles in testing.

As a matter of fact, it is a well-known thing that in gas-burners the air supply must be suitable to the quality of the gas?—It should be Of course, that has been the aim of modern gas-burner makers.

Are you of opinion that the air supply in this burner is suitable?—There are better types than this now; but it is the burner prescribed in the Act.

I do not know that. I find it to be so. At any rate I may tell you that we do not think it is. Suppose I say that, under the second alternative in the section—that is to say "other approved burner," we assert that we

are entitled to use another burner. I want to get from you an expression of opinion as to whether you agree with these statements. I am quoting from——

Mr. HORRIDGE: I object. A book is not in any way evidence.

The TOWN CLERK said he would not mention what book it was. He was going to ask witness whether he agreed with the particular statement, which he would read: "It may be taken as an axiom in gas testing, that the burner by which the consumption of gas under common atmospheric conditions gives the highest lighting value per unit of gas consumed, is that by which the illuminating value of the gas should be determined."

Witness: It depends upon the purpose you have in view. We were working in compliance with the statute, and were limited as regards the burner and apparatus.

The TOWN CLERK: I have gone beyond the 15-hole argand; and am dealing with the question "other approved burner."

The CHAIRMAN: Will you explain what you mean by other approved burner?

The TOWN CLERK: It means suitable.

Mr. HORRIDGE said he ought, strictly speaking, to object to evidence concerning any other burner, in the absence of evidence that it had been approved by the parties.

The TOWN CLERK: Do you agree that gas companies or corporations owning gas-works are entitled to use the burner which develops the light of the gas to the highest point under common atmospheric conditions?

Witness: Under parliamentary sanction.

Apart from that, do you consider it is the right thing to do in testing gas?—Undoubtedly the wrong.

Why is it the wrong thing?—It could be shown under these conditions that Southport gas has an illuminating power of 100 candles, by means of the incandescent gas-burner.

Never mind the burner now. I want you to fix your mind on the gas apart from the burner. Looked at chemically, the better of two samples of gas is the one which contains the highest percentage of hydrocarbons?—Quite so.

Dr. BARRON: Does oxygen play no part in it?

The TOWN CLERK: That is the air supply. We will come to that. Continuing, he proceeded to read as follows: "I recommend that the best burner that is known for the production of the most light from the gas should be employed because burners don't make light; they only educe it."

Witness: Are you asking me to assent to that proposition?

The TOWN CLERK said he was simply reading it, and asking witness to assent to it as being the enunciation of the correct principle for a burner to test gas. The Metropolis Gas Act admitted of burners being used which would show a difference of several candles, according to the way the gas was burned. He could select burners strictly conforming with the Act of Parliament, and yet with the same gas they would get a difference of four, five, or six candles in illuminating power. The fact was one burner would destroy the illuminating power and the other would develop it.

Witness: Quite so.

The TOWN CLERK (reading): "I think the gas companies ought to have the best burner they can get, because you would increase the illuminating power of the gas. The gas has the illuminating power in itself inherently. You may destroy it in a bad burner, but you cannot increase it by a good one." That was an opinion given by witness.

Witness said in the case before the Court the burner was specified.

The TOWN CLERK said he was proceeding under the same Act, and he wanted to put in a burner which came within the words "or other approved burner." That was the reason he wanted to get from Mr. Bellamy the general principles of gas testing.

Dr. BARRON: You must prove that this is an "approved burner" between both parties.

The TOWN CLERK: Not approved.

Mr. HORRIDGE objected to the Town Clerk giving opinions from books.

Witness, referring to the "G" burner produced, said there was a very slight difference between it and the "F" burner. The former was marked "18 candles." There was no arrangement inside it for reducing the pressure. The air supply was different to the modern burners.

The TOWN CLERK: The point of ignition is free from pressure, practically, which is a good thing.

Witness: Yes; for developing light.

You had an interview with the Corporation of Preston, along with the Committee of the Local Board of Birkdale; and on that occasion the question was put as to whether or not you would accept the "G" burner?—No; I think it was the "F" burner.

You were asked whether you would be prepared to approve of Sugg's "F" argand burner, 30-hole with 8-inch chimney. Your answer was, "I distinctly object to this burner, which has been manufactured to yield the highest standard of illuminating power." Now, supposing the question were now put the same way, would you give the same answer?—For the purpose of testing gas in that way, I should say distinctly so. The "F" burner is not the standard burner.

The TOWN CLERK: It is the standard burner in Preston to-day.

Re-examined: The burner he had handed in was an argand, with 15 holes. They wrote to Messrs. Sugg and Co., asking for the most suitable burner, of the 1871 period, for developing the illuminating power of 20-candle gas. He had tested for ten years in Birkdale, and had never had it suggested by the Corporation that the burner used was not an argand with 15 holes.

Mr. HORRIDGE wished to say that on June 22, 1887, the Corporation refused to approve of any suggestion from Birkdale about the burner, on the ground that it was for them to approve of a different burner if there was one required. The question now raised was as to what was the approved burner.

The TOWN CLERK said that, whatever might have happened between the parties in an amicable way, did not bind the Court. There was no bar upon the legal construction of the section; and the question for the Court was what was the meaning of the word "approved."

Dr. BARRON: Have you no written resolution at the time recorded?

The TOWN CLERK: I dare say there is.

Mr. HORRIDGE read a letter, with a copy of a resolution passed by the Gas Committee, which was received from Mr. Ellis, the then Town Clerk of Southport, on June 22, 1887, and which stated that the Town Clerk had informed the Surveyor to the Birkdale Local Board that the Committee would approve of No. 7 steatite burner for testing the illuminating power of the gas.

The TOWN CLERK said this showed they tried to put the matter on a more satisfactory basis.

Mr. HORRIDGE remarked that he wanted to show that nothing had been approved of by either party.

The TOWN CLERK said he admitted that the burners were not approved of by both parties.

Mr. *Isaac Carr* said he took testings of the gas on the 10th of February, and he agreed with the test Mr. Bellamy had referred to. Mr. Booth, the Gas Engineer to the Southport Corporation, made no complaint at the time.

Cross-examined: If the mains were narrow and contracted, it was possible to reduce the illuminating power slightly; but the difference would be infinitesimal. He thought the mains were ample; and he had never seen a district where the pressure was more equally distributed and sufficient. The gas tested on the 10th passed through an ordinary meter; but he did not admit that this had the effect of reducing the illuminating power.

Mr. *Bellamy*, in answer to the TOWN CLERK, said the fact of the gas passing through the meter would have no effect upon the illuminating power.

The TOWN CLERK then opened the case for the defendants. He remarked that he was afraid that the learned Counsel and himself would not be able to agree on the meaning of the section which prescribed the illuminating power of the gas. If his view of the matter was correct, the only satisfactory method of settling this long-standing dispute was by a Provisional Order amending the Act of 1871. If the parties, even in that Court, should come to an agreement on a burner, and the Birkdale District Council gave an undertaking not to oppose them if they went for a Provisional Order to have the burner approved, he was there to say, on behalf of the Corporation, that they would be perfectly prepared to apply for an Order on those lines. But he would say at once, not only to the Court but to the great body of gas consumers within their area, that the Corporation of Southport, as represented by their Gas Committee, had always been of opinion that they were supplying gas of the prescribed illuminating power; and having had occasion, for the purposes of this case, to consult eminent experts, who would be called, they were confirmed in their opinion. Of course, they knew that the difference between the parties was a difference of burners. Mr. Bellamy used a 15-hole argand; they (the Corporation) used a burner which was known as the Silber argand. He had it in Court; and he would like the Bench to look at it. Mr. Bellamy had very candidly admitted that if the tests made in Birkdale on the date now in question—the 18th of February—had been made with the latter burner, the illuminating power of the gas, instead of being recorded as of 16 (odd) candle power, would have been 20 (odd) candles. If it was of this power, it was up to the standard required by Act of Parliament; so that the whole issue was narrowed down to a very limited compass—viz., whether they were entitled to use this burner or any other that would develop, in their opinion, the gas to the best advantage, burning it under common atmospheric conditions. The question narrowed itself down to this simple issue, although there were certain points of law which he would have to put to the Bench, whether the Silber argand was a suitable burner according to the Corporation's interpretation of the words "approved." When once they admitted a burner within this sense, they were entitled to ask leading authorities in the gas world whether, in their opinion, a given burner was a suitable burner; and whether, assuming the word "approved" to mean suitable, such and such a burner would or would not be a suitable one for educing the light from the gas supplied by them. Having referred to the different qualities and the chemical composition of gas, and the methods of testing it, he said his case was that, taking the three ways of regarding the subject—the materials used, the chemical analysis, and the photometrical test (though about this a question would arise)—the same conclusion was reached, that on the day in question the gas supplied by the Corporation was a rich gas.

Dr. BARRON: On the 10th of February?

The TOWN CLERK: Yes. Continuing, he said that the richer the gas, the more oxygen was required to burn it. The supply of air must be proportionate to the quality of the gas; and the supply of air which was suitable to the combustion of 16-candle gas would be totally unsuitable to 20-candle gas, and *vice versâ*. He might tell the Bench at once, as a matter of common knowledge, that the burner question at the time of the passing of the Corporation Act was in a state of chaos. Knowledge upon it was slowly evolving out of darkness; and, as was well known, the Gas Referees of London appointed under the Metropolis Gas Act to settle this very question for the London Gas Companies, were busy during many years examining various burners. They came to the same conclusion that Mr. Bellamy had very properly come to—that the diversity of results obtained from different burners was of the most striking character. He thought it would be admitted that it would be perfectly easy, taking the gas of Feb. 10, to get a 15-hole argand burner that would depreciate the gas enormously, and, in fact, would show it to be of less than 10-candle power, which, looking at the matter from the commercial point of view, would be perfectly preposterous. But it could be done easily; and if the contention of the Birkdale District Council was correct, then they were entitled to come there with these records, and ask the Bench to adjudge that forfeiture.

Mr. HORRIDGE contended that, before making a statement of this kind, the Town Clerk should have put the question to Mr. Bellamy whether he considered it possible for this to be done with the argand burner of the period of 1871. He was instructed it was not possible.

The TOWN CLERK: I am not going to put the question to Mr. Bellamy.

Mr. HORRIDGE: If you are going to say that this burner could be so used as to make a difference of from 10 to 20 candles, then I submit the question ought to have been put to Mr. Bellamy.

The TOWN CLERK said he distinctly asked Mr. Bellamy to tell him whether the same gas could be depreciated or otherwise according to the burner used.

Mr. HORRIDGE remarked that that was quite a different question. Replying to another remark made by the Town Clerk, learned Counsel said that, by an argand burner of 15 holes, he understood the burner to be referred to as known at the time when the Act was passed.

Dr. BARRON asked if it was contended that the Birkdale people went so far beyond what they ought to have done as to supply an argand burner of a different character, which would deteriorate the value of the gas.

The TOWN CLERK: I should not like to put it in that way. I simply say for the moment that it cannot be the 15-hole argand intended by Parliament.

Mr. HORRIDGE: All I know is that the gentleman who provided the burner is in Court; and I hold his letter supplying it as a burner of the period of 1871.

The TOWN CLERK said that his contention was that it was not the 15-hole argand burner prescribed by the Act.

Mr. HORRIDGE pointed out that, when the question of the different burners was discussed five years ago, no objection was taken to the burner in question by the Southport Corporation.

The TOWN CLERK: I do not know the reason why it was not objected to at the time. The broad question for the Court will be whether the Corporation are really keeping faith with their customers; and we say that we unquestionably are doing so. He raised these points because the question might have to be investigated elsewhere. He thought in raising these points of law, he would define the difference between the parties better than in any other way. The first point he made was that, if they looked at section 35, they would find that the Corporation were to supply gas "of such illuminating power as to produce from an argand burner having 15 holes and a 7-inch chimney;" and then came the alternative, "or other approved burner and chimney, or burners," without mentioning chimneys. The first two were, of course, argand burners, because of the chimneys; but the other one would be the flat-flame burner, which they could use if they liked. When an obligation was passed in the alternative, he contended that the person to choose such alternative was the person under the obligation.

Dr. BARRON pointed out that, whichever burner was used, according to the section it must consume 5 cubic feet of gas per hour.

The TOWN CLERK said that the Chairman had mentioned a most important point, with which he would presently deal. The Corporation chose not to give gas as measured by any 15-hole argand burner, because, as was very fairly admitted by Mr. Bellamy, a 15-hole argand was not suitable for developing the best illuminating power that the gas could give. As he had said, in 1871 the burner question was in a state of chaos; and the London Referees published their report just as the Corporation Act received the Royal Assent.

Mr. GIBSON remarked that the 15-hole argand was one of the first burners used.

The TOWN CLERK said that the original or 15-hole argand was made of iron. This was the London metal 15-hole argand. After that, there was a Birmingham argand, made of brass; and then came the steatite, with a bit of steel on the top, which they would find in the burner used by the Birkdale people. This was slightly better than the old argands; and the Corporation said that they were generous in that respect. Then came a burner not only with the little strip at the top, but with the whole chamber made of steatite. The fact was there were several 15-hole argands in 1871; and there were Acts of Parliament where the dimensions of the burners prescribed were given. This was not, however, the case in the Southport Corporation Act. Proceeding to deal at some length with the different argand burners, he said that the "G" and Silber burners, which were both adapted to a superior quality of gas, were simply adaptations of the standard London argand for 16-candle gas. The word "approved" in the Act meant suitable. He thought he would be able to satisfy the Bench that it did not mean approved by the parties, because it would lead them to a result which would be perfectly preposterous, as any five of the Corporation customers would be able to find fault with the burner used. Section 39 of the Act said that "any Justice, on receiving a requisition signed by not less than five consumers of gas, may, by order in writing, appoint some competent person to proceed to the works." If the argument used on the other side was right, it would be competent for any five consumers within the limits of the section to say that they had not approved of this particular burner. That was to say, it would be competent for them, if the Corporation were bound to use a 15-hole argand. But the Act said this argand, or any other approved argand, or a burner which was not an argand at all. His opinion was that it was a perfectly simple construction that the word "approved" could not mean approved by the parties. The third point he made was closely connected with the first; and it was that the testing-meter should be furnished with the same burner as the Southport testing-meter. According to section 38 of the Act, they were under an obligation to do a certain thing. It said: "Within six months after the passing of this Act, the Corporation shall provide in some part of their works a proper and sufficient testing-meter, furnished with an argand 15-hole burner and a 7-inch chimney, or other approved burner and chimney." Then, if they went on further, they would find that "the Local Board may, if they think fit, provide within the township a like testing-meter"—that was to say, a testing-meter furnished in the same way as that of the Corporation. The Local Board had no right to put up a different meter, and furnish it with a different burner. If they thought the Corporation were not acting properly, their plan would have been to have gone to the High Court for a mandamus, calling on them to furnish a burner within the meaning of the Act. This was not the course they had adopted. If the Birkdale Local Board were entitled to use a 15-hole argand, notwithstanding the fact that the Corporation had a different burner in their meter, then the point he raised was that it must be such a burner as was capable of testing 20-candle gas at the prescribed rate of consumption. The prescribed rate of consumption was given in the Act itself, and also in the General Act of 1871. It said there that the consumption of gas was to be carefully adjusted to 5 cubic feet an hour. They were not entitled to burn less and count up, or burn more and count down. The burner used, whatever they might call it, or whatever it might be, must be a burner that could consume 5 cubic feet an hour, and be capable at that rate of burning of equalling 20 candles. It was for the prosecution to prove that the burner they put forward was the burner mentioned in the Act. It must be shown further, that it was a 15-hole argand, capable of consuming gas of 20-candle power at the prescribed rate; but this had not been proved. On that point, he was going to show that the burner smoked long before it got to 20 candles as measured by itself. Just before it began to smoke, they got the maximum capabilities of the burner for testing at the prescribed rate. They tested the burner in another way, and by an equally good method. The test he had already mentioned had been made at the gas-works at Southport. Of course, the Bench knew that, as a matter of fact, the burner was marked 18 candles; and the air supply was adjusted according to the richness of the gas. The air supply suitable for 18-candle gas would not be suitable for 20-candle gas. They tested the burner at the gas-works, enriching the gas until it began to smoke, when they found that it fell far short of 20 candles. One of the witnesses who would be called (Mr. Sugg) had been making some experiments in London. He performed the test in another way altogether. He first of all got 20-candle gas as measured by the very best method that science had yet invented. He timed it against the standard light that was called the pentane flame—which was recommended by the Committee appointed by the Board of Trade. Then he tested the gas with a 15-hole argand burner similar to the one used by the Birkdale authorities. He also found that it smoked. Therefore it was not capable of testing 20-candle gas at all. The conclusion he wanted the Bench to come to was that where the Legislature prescribed a 15-hole argand for 20-candle gas, they must have meant a 15-hole argand capable of testing the quality of the gas, while this burner was not. With reference to the specific date of Feb. 8, they took the precaution to impound a quantity of the gas made on that day, which was sent to Professor Lewes, who would give the results of his analysis. Dr. Frankland, the well-known chemist, would also state the percentage of hydrocarbon in a sample of gas impounded March 5. The next point he would put was that the test of the Birkdale District Council was not performed by them as consumers of gas. If they had been making it as consumers, they would have done so under section 39, where it spoke of five consumers of gas or the Local Board, which he took to mean the Local Board as consumers. But they had an independent power, according to the Act, to do a certain thing; and if the case had turned on the small fraction of a candle, he would have had to lay before the Bench the point that the responsibility of the Corporation in relation to the District Council ended if and when they delivered 20-candle power gas into the Birkdale mains, over which they had no control. The tests that were made at the works in February and March gave over 21-candle power. The question for the Bench to decide was whether, if the gas had been tested at Birkdale by an approved burner, within the meaning of the Act—that was to say, a burner suitable for developing the best light the gas could give—it would have proved of 20-candle power. In conclusion, he said that, if his view of the word "approved" was correct, no one could dispute that a burner which was a natural evolution of the London argand, and a standard burner, was a suitable burner for testing purposes.

Professor *Vivian B. Lewes* was the first witness called on behalf of the Corporation. He said he was a Professor of Chemistry at the Royal Naval College, Greenwich, also Chief Gas Examiner to the Corporation of the City of London. He was Secretary to the Departmental Committee appointed by the Board of Trade a few years ago on the photometric standard question. For some 17 or 18 years he had devoted attention to the photometry of coal gas. He was well acquainted with the methods applied for this purpose, and the forms of the burners in the photometers which had been made legal by Act of Parliament from time to time. He had gone into the subject of the difference between the parties in this case. It was simply a question of the burner to be used. He had made several tests with the Silber argand used at Southport, compared with the 15-hole burner; and he confirmed Mr. Bellamy's opinion that the difference between them was about 4·6 candles. He was able to speak of the history of the gradual evolution of the argand burner. Soon after the invention of coal gas, argands were introduced. They were two concentric tubes, one in the other, between which gas was allowed to pass and burn in a circle. No attention was given to the regulation of the air or the pressure of the gas. Then the idea came in of closing the circular space at the top, by means of a ring of metal bored with a number of small holes; so that the gas, instead of coming out in a big mass, issued in little jets. These holes were bored close enough together to cause the jets to coalesce, so as to form a ring of flame. Early in the fifties, they had most Provincial and London coal gas tested with a burner of this character, made of iron, with 15 small holes in a circle. Late on in the fifties, the iron burner was replaced by what was known as the Birmingham argand, made of brass; and in 1859, a great improvement in burners was introduced by Dr. Letheby. He took a Birmingham brass burner, and placed in the top a steatite ring. The steatite not being a good conductor, they had the heat remaining in the flame, which increased the illuminating power. This burner gave 12 per cent. more light than the Birmingham burner. The Letheby argand was introduced, and underwent a slight modification. There was also a 15-hole argand known as the Leamington burner. Formerly, with the exception of Birkdale, Leamington was the only place where they used it. In London, at that time they had the Letheby 15-hole Argand burner, which it would be more correct to call the Sugg-Letheby. It had holes of different sizes, so that they would burn from 12 to 18 candle gas. There was a large space in the centre of the burner; and, of course, inasmuch as the air supply to the flame was one of the main factors of combustion, it made a considerable difference in this burner compared with others. The burner they used at Birkdale was one of this class—constructed for the consumption of 18-candle gas. About 1871, another great improvement was made—namely, the introduction by Mr. Sugg of what was termed the London argand. The great and enormous improvement which took place then was that for the first time they had a proper regulation of the air draught. In the centre, there was a small tube, which prevented a rush of air; and round the inside of the lamp was placed a truncated metal cone, which caused the air to go in and strike

at the base of the flame, and so improved its combustion. In all previous burners, the gas had been allowed to go up through fairly broad tubes into what was practically the reservoir of the burner; and the area of the holes was always smaller than that of the tubes which led up to them, so that there was a certain amount of pressure on the holes. The Silber argand burner, which was somewhat similar to the London argand, was introduced in 1868; and the distinctive feature about it was that provision for the pressure at the point of ignition was reduced to zero. He had made some experiments with the Corporation gas at Crowlands; and he found, with the Leamington 15-hole burner, and burning enriched gas, that when the register indicated between 17 and 18 candles it began to smoke. That was to say, he could not get a consumption of 5 cubic feet with enriched gas without smoke arising. This showed there was improper combustion of the gas. He could not say that the Leamington and the Letheby burners would give like results; but that they were burners of the same class. In 1871, they used to have the 15-hole argand burner very generally prescribed. It was made in several forms. The burner used in Birkdale was one of them; and it was of the 1871 date, since when modifications had taken place. If 20 candles were obtained by the Leamington burner, he should say there must have been a feeble burning of the candles.

The TOWN CLERK asked if it was not a fact that in 1881 a report, which became a Parliamentary Paper, was presented to the Board of Trade on the photometric standard, in regard to candles.

Witness: There have been several photometric standard reports.

The TOWN CLERK said he took it that the result of the report showed a wonderful diversity in the candles.

Mr. HORRIDGE objected to this question. It was possibly illegal. It was giving, in the second place, the result verbally of a document which the Town Clerk could not put in; and, in the third place, what the Photometric Committee did was irrelevant to the inquiry before the Court.

Witness proceeded to deal with the result of his experiments for the Committee. He said he found there was a wide diversity. Under one set of conditions, the candles would burn better than at other times. It was very rarely candles would burn alike. They had to make an adjustment of the candles. Allowances were made; but there were still differences which made the candles unreliable. This had been the gist of the reports of Committees for the last two or three years. In February, he received a sample of the Corporation gas, and made a chemical analysis of it; and he produced the results.

Mr. HORRIDGE objected. The Act said that the gas should be tested in a certain way. "As aforesaid" were the words used; and he objected to any analysis being put in.

The TOWN CLERK said he wanted to bring evidence to show that they impounded the gas, and had it analyzed.

Mr. HORRIDGE said the gas impounded at the Southport Gas-Works was not that supplied to Birkdale. When so tested "as aforesaid," meant tested according to the Act of Parliament.

At the TOWN CLERK'S request, the Magistrates' Clerk made a note of the refusal to receive this evidence.

Witness was asked by the TOWN CLERK if he considered the Silber burner suitable for educing the light of gas; and he replied in the affirmative. He considered the Silber burner and the "G" burner the same.

Cross-examined: The enricher used by him at the time the chimneys smoked, was oil gas. There were some works in the country that used coal gas of 20-candle power. One was liable to get smoke by using enrichers; but it depended upon the way they were used.

Mr. FORMBY asked if there was any difference in the chemical richness of 20-candle power gas made by pure coal and 20-candle gas enriched by oil?

Witness said that was an excessively complicated question. If they made the oil gas according to one process, they would get a very high proportion of what were known as saturated hydrocarbons; and more air would be required to break them up.

Mr. HORRIDGE referred to a letter written by the Town Clerk, dated Nov. 7, 1894, which contained the results of testings equal to 15·91 and 14·85 candles; and also to testings made in September, 1894, equal to 15·20 and 19·47 candles respectively. On June 19 and 20, 1894, the testings showed 19·95 and 18·8 candles respectively. He understood the witness to say that when he made these tests, smoke arose at 17 candles.

Witness replied that that was so.

Mr. HORRIDGE: And supposing the candles were according to Act of Parliament, and the proper adjustments were made, and an average of ten tests taken, could you account for the reason why, when it showed 19·9-candle power, smoke should arise?

Witness replied that this might be owing to the candles burning badly, and the unit being very low. The temperature of the retorts might also have run up; and they would get consequently a greater decomposition of hydrocarbon. In the ordinary course, with gas of the character produced at Southport, the burner used would not show 20 candles when the gas was burning at the regular rate of consumption—5 cubic feet. With the register they had, they might get from 18 to 19 candles; but it would smoke from 17.

Mr. HORRIDGE pointed out that on June 19 there was registered 19·95, and on June 27, 18·91 candles.

Witness said it must be remembered that the burner they had was for 18-candle gas; and in all probability it would, with anything approaching nominal gas, register close on 19 candles. Then they would afterwards go back and make a richer and richer gas. The burner would then become more unsuited for its combustion; and the result was they would get a lower reading from it. It became impossible some years ago for managers to supply gas enriched by cannel; and other methods were adopted, the best of which was oil gas.

Mr. HORRIDGE said he might take it, then, that the highest result they had was a chance testing.

Witness went on to say that they tested 25-candle gas with the burners used at Birkdale. This burner would register 18½ candles; and at 19 candles, it would begin to smoke. He admitted that in 1871 the 15-hole argand burner was generally used in the country; but he was quite sure that at that time Parliament approved of the London argand. It was in 1859 that the Referees sanctioned the London argand. He did not say that the 15-hole argand burner was the only one used in the country at the time.

By the TOWN CLERK: The London argand was known as the Sugg new argand No. 1. The difference in the results of this burner and the one previously used in London was something like 20 per cent. He did not know of any other argand of 15 holes of the 1871 period which was of 20-candle power.

Dr. *E. Frankland*, F.R.S., said he was Consulting Chemist to the Local Government Board. Since 1851, he had paid much attention to the illuminating power of coal gas. He had published papers on the subject. One was on the "Source of Light in Luminous Flames." He had experimented with the 15-hole argand burner as used at Birkdale; but he could not make it burn 5 cubic feet per hour. He agreed with Professor Lewes that the Silber argand and the "G" burner embodied the distinctive principle of the standard London argand. The Silber argand or the "G" burner was suitable for educing the light from the quality of gas supplied.

Mr. *John Booth*, Engineer and Manager of the Southport Corporation Gas-Works, said that he had held this position for seven years. On Feb. 10 last he tested the quality of the gas. The enrichers used were Wigan 4 feet coal, which contained a percentage of cannel, and Wigan Arley coal, which was the best gas-making coal in the Wigan district. Among other enrichers, were Branwick and Starley cannel. And there was also some Russian solar oil used. The test was made on Feb. 10, with the Silber argand burner.

Mr. HORRIDGE said he objected to any tests except those referred to in the Act of Parliament.

The TOWN CLERK said that the tests were taken by Mr. Booth's assistants at the same time that they were made in Birkdale, for the sake of comparison.

The BENCH ruled in favour of Mr. Horridge's objection.

Mr. *Thomas Newbigging*, M.Inst.C.E., said his experience in the manufacture of coal gas had extended over 40 years; and he had done a very large amount of work in testing the illuminating power of gas. He had recently made a test of the Southport gas, with a 15-hole argand burner similar to the one used by the Birkdale Council. He found that, at a point short of 20 candles, it smoked. From his knowledge of the ascertained laws of gas combustion, he was prepared to say the Silber burner was a perfectly suitable burner for educing light from gas.

Mr. HORRIDGE, in cross-examination: The more holes there are, the more illuminating power you get?

Witness: Not necessarily.

Mr. *William Sugg*, Assoc.M.Inst.C.E., said he had made an experiment with the 15-hole argand burner used by the Birkdale Counci with the view of ascertaining the highest quality gas it was capable of consuming properly. He made one experiment at the Southport Gas Works; and he found the burners smoked at a point short of 20 candles. He also found the same result when he made an experiment with the burner there. The London argand burner was the one adopted as the standard for 14 and 16 candle gas. They only wanted 16-candle gas in London; whereas in Southport they must make it up to 20 candles, by using enrichers. The Silber argand embodied the distinctive principle of the London argand. If the test at Birkdale had been made by the Silber or "G" argand, there would have been a record of over 20 candles.

Cross-examined: There were no 15-hole argand burners made in 1871 for more than 18-candle gas.

Mr. HORRIDGE, finally addressing the Bench on the point of law raised by the Town Clerk, contended that an argand burner was a burner laid down by the Act; and he submitted that the words "or other approved burner" could not mean any burner which might be invented. It must mean a burner which was approved of by both parties. He asked the Bench to find in his favour, not only on the ground that it was the 15-hole argand burner, and not "any other approved burner," that the Act of Parliament clearly meant to be used, but from the fact that there was no other approved burner at the time when the Act came into operation. The burner must be approved by the parties, or by Act of Parliament. He asked the Bench, if they convicted the Corporation, to inflict the full penalty. The Town Clerk said on the last occasion that it would make a difference of £10,000 to the Southport Corporation; but he might say that the loss to Birkdale from the bad quality of the gas was something like £13,000.

Mr. *Bellamy*, recalled, said he took two tests on the 19th and 27th of June, 1894, which gave respectively 19·95 and 18·81 candle power. They were the highest results he ever obtained.

The TOWN CLERK said he wanted the decision of the Court to be given in a form which would enable them to finally settle the question. It had been hanging over them for many years; and he was extremely anxious that it should now be disposed of. Inasmuch as it involved large pecuniary considerations, they wanted it settled in a manner that would be satisfactory.

The Magistrates retired, and on returning to Court,

The CHAIRMAN said that they found the offence charged in the summons was proved, and that as a fact there was not, at the date of the Act of 1871, any approved burner capable of testing 20-candle power gas. They fined the Southport Corporation £10 and costs.

The TOWN CLERK asked the Magistrates to give their definition of the approved burner.

Mr. HORRIDGE objected, because he was prepared to take the finding as it was given. He added that the costs had been agreed upon at 75 guineas, which included the 25 guineas for the last adjournment of the proceedings.

The TOWN CLERK asked if the Court would grant a case on a point of law?

The CHAIRMAN: We have no desire to refuse a case.

The other two cases of the 5th and 7th of February were then briefly gone into; the testings being equal to 16·25 and 15·93 candles, or an average of 16·09 candles on the first date, and 15·90 and 16·20 candles, or an average of 16·05 candles on the second date.

The TOWN CLERK consented to the first decision ruling these two; and the Magistrates imposed a penalty of £10 in each case.

Conviction for Selling Worthless Incandescent Gas-Burners.

At the Central Criminal Court last Tuesday, Thomas Wilson, 30, a plumber, was indicted for obtaining money by false pretences. Mr. C. F. Gill and Mr. F. Owen prosecuted; the prisoner conducted his own defence. The prisoner had inserted advertisements in a newspaper offering incandescent gas-burners for sale at 5s. each complete; and he also advertised mantles for incandescent burners at 1s. each. A number of persons purchased burners and mantles of him; but it was alleged that they were found to be worthless for lighting purposes. Prisoner's defence was that he had carried on a *bonâ-fide* business, and that he had supplied a large number of burners and mantles which were perfectly satisfactory. He called several witnesses in support of his defence. The jury found him guilty; and a previous conviction having been proved, he was sentenced to nine months' hard labour.

The Charge of Perjury in Connection with the Southwark Bridge Explosion.

At the Central Criminal Court last Thursday, before the Common Serjeant, James Price, 38, a lighterman, was indicted for having committed wilful and corrupt perjury. Mr. Horace Avory and Mr. Biron prosecuted. The prisoner brought an action in the Lambeth County Court against the South Metropolitan Gas Company, claiming damages for injuries he alleged he had sustained owing to a gas explosion on Southwark Bridge early last year. He was awarded £12; and as the appeal entered by the Company was dismissed with costs, the Company paid the award and the costs. It was subsequently found that the prisoner had been compensated for injuries he alleged he had sustained by falling over a grating belonging to the American Wringer Company. This accident occurred some time before the date of the explosion on Southwark Bridge; but its importance in the case was this—that, on inquiry, it was discovered that, about an hour after the explosion, the prisoner was at the offices of the American Wringer Company, and was paid 30s. compensation, and that then he certainly was not suffering from the injuries he afterwards stated on oath in Court he received in consequence of the explosion. Witnesses were also called to prove that the prisoner was not one of those who were then injured. The jury found the prisoner "Guilty." Previous convictions having been proved, he was sentenced to three years' penal servitude.

Reckless Misuse of Water.

At the Stratford Police Court on the 20th inst., Mr. J. J. Wheeler, of Copeland Works, Lea Bridge Road, Leyton, was summoned by the East London Water Company for using water for other than domestic purposes without having an agreement to do so. Mr. George Kebbell, who appeared for the Company, said the information was laid under section 18 of the Water-Works Clauses Act, 1863, which provided that any person not having a supply of water for other than domestic purposes and using water for such purposes was liable to a penalty of 40s. An agreement could be made with the Company to take water for garden purposes; but the defendant had no such arrangement. His premises had been watched from April 18 to June 2; and it was repeatedly noticed that at the back of the place there was a pipe turned on full, capable of wasting 400 or 500 gallons an hour. On Sunday, May 24, at six o'clock in the evening, the tap was turned on full, the drain which ran from the back was stopped, and the water was allowed to flow into the garden and form a large lake in which about 20 ducks were swimming. This was at a time when the rainfall was only 4 inches—the average being 25 inches; and, in spite of this scarcity, the water was being shamefully wasted. Mr. Kebbell added that on Saturday, June 6, the consumption of water in the East London Company's district exceeded that of the previous week by 30 million gallons, and was caused simply by reckless consumption. When the Local Government Board held an inquiry last year, the report contained a clause that the scarcity of water was due to excessive garden watering during May and June. The Company hoped that in this case such a penalty might be inflicted as would have a deterrent effect upon others, for he could assure the Bench that this was not an isolated case. If the waste was not stopped, the Company would in a few days have no alternative but to shut down the mains. Four witnesses were called to prove the case. In the pond were about 20 ducks; and after the water had gone away, water was being thrown on the garden through a hose. Defendant and other residents in the neighbourhood had often been cautioned against watering gardens. Defendant did not appear, but sent a representative, to whom, however, the Bench said they could not listen. They fined the defendant the full penalty of 40s. with Court costs and the Solicitor's fee; or, in default, 14 days' imprisonment.

Disputed Water-Rent.

At the St. Austell County Court, on the 15th inst., before His Honour Judge Grainger, an action was brought by the Urban District Council against Richard Parsons for the recovery of 5s. water-rent. The evidence of the collector was to the effect that the defendant occupied premises for which prior to March, 1895, he paid water-rent assessed on the rateable value of the house, with extra charges of 4s. per annum for a bath, water-closet, and garden tap. After this time an alteration was made in the mode of levying the rate. A properly made water-rate was assessed on all the urban district; and this covered all domestic supplies, including bath and closet, but not the garden tap, which remained a separate charge, though the amount was increased from 4s. to 5s. In cross-examination, witness said that the usual public notices with respect to the change were posted in the district. Defendant contended that under the Public Health Act, an agreement was necessary for water-rent; and in this case there was no such agreement. The collector said defendant had paid the charge for many years without a special agreement. His Honour held that the variation in the charge had created new conditions, and that an agreement must be made to render the rate legal. He therefore gave judgment for the defendant, with costs.

The Incandescent Gas-Light Patent in France.

The Tribunal Correctionnel on the 19th inst. pronounced judgment against certain infringers, makers, and sellers of incandescent gas-burners. The decision appears to be important in the interests of the French Incandescent Gas-Light Company, inasmuch as it defines, in the most decisive manner, the patentable character of the invention, and declares that the invention depends less on the actual nature of the materials employed than on the process of manufacture of the mantle. The judgment discards the anticipations set up against the patent; declares the description of the patent completely sufficient; rejects the plea of the patent having lapsed by reason of non-manufacture within the time legally specified, and of the importation of the impregnating fluids or of articles made abroad; and formally recognizes the existence of the infringements. The Tribunal condemned each maker in a fine of 500 frs., and each seller in a fine of 300 frs., the damages to be further assessed by the Court. The defendants are further ordered to insert, at their own cost, a copy of the judgment in twelve newspapers to be chosen by the Company.

Gas v. Electricity at Tunbridge Wells.—The Engineer of the Tunbridge Wells electric lighting works having sent out a circular to consumers, asking for a return of the number of electric lamps used and gas-burners replaced, as well as the comparative gas and electric light bills for the quarter, the Gas Company have issued a counter-circular, pointing out that the action of the borough authorities in putting forward such a request is unfair and misleading in the form of return; and consumers are therefore requested not to fill in the paper sent to them, but a form enclosed by the Company. This issue of the two circulars has created some amusement in the town.

English Incandescent Gas Share Company, Limited.—The report of the Directors of this Company, which was submitted to the shareholders at the first annual general meeting last Friday, stated that the net profits for the year derived from the dividend paid by the Incandescent Gas-Light Company, Limited, amounted to £76,415. To this must be added the sum of £24,529, the amount of the commission paid to Mr. Moeller by the Incandescent Gas-Light Company, Limited, and assigned by him to this Company in accordance with the agreement entered into between him and the Company. There was thus a total of £100,944 available for dividend, of which the sum of £74,155, equivalent to 15 per cent., had already been paid; and the Directors recommended a further 5 per cent., free of income-tax, by way of final dividend. This absorbed £24,718, and left a balance of £2071 to be carried forward.

New Joint-Stock Companies.—The well-known firm of Messrs. Forbes, Abbott, and Lennard has been converted into a limited liability company, with a capital of £250,002, divided into 5000 preference shares of £10 each and 18,182 ordinary shares of £11 each. The object is "to adopt and carry into effect an agreement expressed to be made between J. Abbott, J. Forbes, F. Lennard, and F. Ince of the one part, and the Company of the other part, for the acquisition, by purchase or otherwise, as a going concern, of the business now and hitherto carried on at London, Shoreham, Rye, Greenwich, and elsewhere, under the style or firm of Forbes, Abbott, and Lennard, and to carry on, in all or any of their respective branches, the businesses of chemical manufacturers and merchants, coalowners, ironmasters, saltmasters, distillers, dyers, &c." The first Directors (of whom there shall be not less than four) are J. Forbes, J. Abbott, F. Lennard, and F. Ince. The Phœnix Coal and Cannel Company, Limited, has been registered with a capital of £25,000, in £1 shares, to adopt an agreement with E. P. Steer, and to acquire, work, and develop the New North Leeswood Collieries and Brickworks, Leeswood, Flint. The Denayrouze Light Syndicate, Limited, has been registered with a capital of £25,000, in £1 shares, to carry on the businesses of manufacturers and dealers in apparatus of all kinds for increasing the illuminating power of gas, spirits, oil, and other light-producing agents, suppliers of light, heat, electricity, and motive power, electricians, chemists, engineers, &c. The German Incandescent Gas Share Company, Limited, has been formed with a capital of £500,000, in £1 shares, to invest its capital in shares of the Deutsche Gasgluehlicht Aktiengesellschaft of Berlin.

Gas Affairs at Milton.—At a meeting of the Milton District Council last Tuesday, Mr. Simmons asked how it was that Mr. Jordan, who was paid to collect the gas-rates, did not collect the money from the prepayment meters, but left this work to be done by Mr. Pike, the Manager of the Gas-Works. Mr. Hampton said he supposed Mr. Jordan was not able to do the extra work entailed by the adoption of prepayment meters. Mr. Pike took the register, and accounted to Mr. Jordan for the money. Mr. Simmons said he did not think the prepayment meters were much good, for they found one contained 3d. less than there should be to pay for the gas registered, another had 3d. too much, while a third was so full of coppers that it would not work until the money was taken out. At Maidstone, most of the "penny" slot meters had been done away with, and "shilling" meters were used instead. Mr. Pike said it did not matter to him whether he cleared the meters or not, but be might say at once that the prepayment meters were, in his opinion, working most satisfactorily. He was not aware of there being any meter which did not contain sufficient coppers; and as to the one which had the 3d. too much, the extra coppers were left in to make even money, as fractional parts were not collected. The Chairman said shilling meters would, no doubt, be shortly adopted; and Mr. Simmons would then probably be satisfied. The Clerk produced the annual return of the gas-works, from which it appeared that the total receipts amounted to £1495 16s. 7d.; and the total expenditure, to £1317 16s. 3d. Adding the expenses upon loans, the profits were practically *nil*; but the Council resolved that they would make a reduction of 1d. per 1000 cubic feet in the price of gas.

MISCELLANEOUS NEWS.

MANCHESTER CORPORATION GAS AND ELECTRIC LIGHT SUPPLY.

Annual Reports of the Gas and Electric Light Committee.

The reports on the working of the Gas and Electric Light Departments of the Manchester Corporation, with the accounts for the year ending March 31 last, have been issued by the Committee; and they will be presented to the Council to-morrow. We have, as usual, received copies of the documents from the Superintendent (Mr. Charles Nickson). The report on the progress of the gas undertaking is as follows:—

Your Committee desire to report that, notwithstanding the extended use of the electric light in the central portion and in the leading thoroughfares of the city, and the unusually bright and open weather of the past winter, the business of the Gas Department has continued prosperous, and the results of the year's working satisfactory. The increase in the consumption of gas for the year was 2·16 per cent., as compared with 4·28 per cent. in the previous year.

The following tabular statement shows the quantity of coal and cannel carbonized and gas distributed as compared with the previous year:—

	Coal and Cannel Used. Tons.	Gas Made per Ton. Cubic Feet.	Gas Sent Out from the Works. Cubic Feet.	Gas Unaccounted for. Cubic Feet.	Per-centage of Loss.
1896	375,514	10,025	3,762,570,000	116,560,000	3·10
1895	364,895	10,084	3,683,067,000	103,634,000	2·81

The average illuminating power of the gas sent from the works was equivalent to 19·55 standard sperm candles, as against 19·16 candles for last year.

The following statement shows the quantity of coke, tar, and ammoniacal liquor made as compared with the previous year:—

	Tar.		Ammoniacal Liquor.		Coke.	
	Total Quantity. Tons.	Yield per Ton. Gallons.	Total Quantity 10-oz. Strength. Gallons.	Yield per Ton. Gallons.	Total Quantity. Tons.	Yield per Ton. Cwt.
1896	23,950	12·44	10,472,084	27·89	235,173	12·53
1895	25,110	13·42	10,177,248	27·90	231,125	12·67

The number of gas consumers in the city was 70,546, and beyond the city 16,696; making a total of 87,242, as against 66,345 within the city and 15,944 beyond the city last year—being a total increase of 4953, as compared with 652 for the previous year. The average consumption of gas per consumer in the city was 40,400 cubic feet, and beyond the city 26,711 cubic feet, as compared with 42,208 cubic feet and 27,743 cubic feet last year. The number of gas fires and cookers in use was 8019, and the number of gas-engines 1112, as compared with 7040 and 983 respectively for the year ended March 31, 1895. The quantity of gas used in these appliances is estimated at 210,500,000 cubic feet; being an increase of 13·48 per cent.

The facilities given for the use of gas in connection with prepayment meters by supplying boilers and brackets free, have resulted in a large increase in the use of these machines in small cottages. The number of these meters in use at the end of the financial year was 3883, as compared with 1481 in the previous year—an increase of 2402. The quantity of gas consumed by these meters was 22,770,000 cubic feet—an increase of 16,290,000 cubic feet, or 251·39 per cent., on the previous year. The demand for prepayment meters has been greater than the capacity to supply. They are now quite satisfactory as to correctness, and are a convenience highly appreciated by the users.

The total revenue in the past year was £523,216, as compared with £579,278 in 1895; being a decrease of £56,062. The amounts received are as follows:—

	1895-6.	1894-5.
Gas-rentals within the city	£323,052	£361,467
Gas-rentals beyond the city	69,817	74,693
City Fund, for street lighting	43,387	46,058
Coke	40,634	46,077
Tar	27,411	18,905
Ammonia water	18,584	31,705
Sundry receipts	331	373
	£523,216	£579,278

The decrease in the amount of revenue from gas-rentals arises from the reduction of 3d. per 1000 cubic feet in the price of gas both within and beyond the city, and the abolition of meter-rents within the city. These concessions were estimated to amount to about £56,100; but, in consequence of the increased consumption of gas, the actual loss of revenue from these sources has been only £46,511. There has also been a reduction in the amounts received for coke of £5443 and for ammonia water of £13,121. There has, however, been an increase of £8506 in the amount received for tar.

The amount paid for coal and cannel, including cost of unloading, was £230,330, as compared with £244,012 last year. The cost per ton carbonized was 12s. 3·21d., against 13s. 4·50d. for the previous year—a gain to the Committee of 1s. 1·29d. per ton in the purchase of coal and cannel, which on the total carbonization amounts to £20,794.

The gross profit on the year's working was £88,063 15s. 11d. The sum of £31,049 15s. 9d. was paid for interest, and £17,734 10s. 9d. has been placed to the sinking fund (as required by the Acts of Parliament under which the money is borrowed). The net profit, therefore, amounted to £39,279 9s. 5d., the whole of which was paid over to the city fund, together with the sum of £2775 19s. 10d. transferred from the contingent fund account; making a total of £42,055 9s. 3d. paid to the city fund during the year.

The whole of the works and plant have been kept in a state of thorough repair out of revenue. The following are the capital and renewals accounts:—

	Capital Account.	Renewals Account.
Gaythorn station	£1,216 17 7	£107 19 6
Rochdale Road station	8 16 7	556 14 8
Bradford Road station	39,828 9 7	6,069 13 3
Droylsden station	641 14 1	145 9 4
Street-mains	9,838 14 2	2,760 19 0
Service-pipes	1,328 14 5	3,986 3 2
Meters	12,310 6 3	3,753 10 6
Stoves	2,145 7 8	218 14 10
Stoves showroom, Deansgate	981 18 2	..
Land for Ship Canal Wharf	10,075 9 5	..
Property in Victoria Gardens and Mill Street, Bradford	2,009 10 3	..
	£80,385 18 2	£17,599 4 3

The new holder at the Gaythorn station has been in full use during the past winter, and has enabled your Committee to ensure a good and regular supply of gas being sent into the rapidly increasing districts to the south and south-west of the city.

There have been practically no extensions or extra renewals of works at the Rochdale Road station during the past year. Important improvements are contemplated during the next two or three years, which will be duly reported upon as they from time to time are decided upon. The tank for the large gasholder at the Bradford Road station is completed, and has been tested with 6,500,000 gallons of water to a height of 6 feet above the "dumpling," and found to be thoroughly tight and satisfactory. The gasholder is now making good progress, and is rapidly approaching completion. It is expected that, by the time this report is issued, the holder will be ready again to be tested with water; and there are good grounds for hoping that this large holder (of 7 million cubic feet capacity) will be available for the storage of gas in the ensuing winter, and largely aid your Committee in giving a full and regular supply of gas in the darkest days. An additional quantity of land adjoining these works has been purchased at a cost of £2009 10s. 3d., which amount will be covered in a few years by the small cost at which rubbish from the works can be tipped on this land, which will then be available and valuable for building purposes or extension of works. The arching over of a length of the River Medlock of about 178 yards is in progress, and will be completed in the next few weeks. This improvement will also add to the land available to the Committee for tipping purposes and for future extensions. The tenders for the buildings, machinery, tanks, &c., required for the carburetted water-gas plant have been let, as reported from time to time to the Council; and the work is making fair progress. The method of making gas for which this plant is designed will be found of great service to your Committee in cases of sudden fogs and long-continued dark weather, when the consumption of gas becomes exceptional. The settings of inclined retorts at the Droylsden station continue to work efficiently and economically. The plant required in the experimental system of purification, referred to in the report of last year, is now completed, and the practical results are being watched with care, and will be reported upon in due course.

The street mains and services have been kept in good condition. The loss of gas from leakage and condensation has been 3·10 per cent. The total length of mains laid is 736½ miles and 322 yards.

The business done at the stoves show-room in Deansgate since September, 1895, when the premises were opened, has been satisfactory, and gives evidence of an increasing demand for gas for cooking and heating purposes. The number of articles sold from Sept. 25, 1895, to March 31, 1896, was 401; new cookers and heaters purchased for hire in the year ending March 31, 502; stoves issued on ordinary hire during the year (including new stoves and re-issues), 1158; stoves issued on hire-purchase, 37; stoves cleaned and repaired, 693.

In the course of their report on the Electric Light Department, the Committee say:—

The number of consumers at the close of the year ending March 31, 1896, was 1148; being an increase of 407 as compared with the previous year. The number of lamps connected was 89,294 incandescent (of 8-candle power) and 806 arc, as compared with 60,632 and 385 respectively. There were also 47 motors at work, representing 54½-horse power; being an advance on the previous year of 30 motors, equal to 38½-horse power. The total length of mains laid was 113 miles 742 yards. The total quantity of current accounted for was 1,801,429 units, or 93·49 per cent. of the quantity produced.

The financial results of the year have been good. The net profit, after defraying all charges for cost of production, &c., provision for renewals, sinking fund, and interest on loans, amounts to £11,138 10s. The amount derived from sales of current (which works out to 4·97d. per unit accounted for) was £37,369 4s. 4d.; the meter-rents received amount to £883 8s. 3d.—making a total income of £38,252 12s. 7d. The expenditure was £14,211 5s. 2d.; to which is added the amount transferred to the renewals account, £3491 14s. 9d.—together, £17,702 19s. 11d.—showing a gross profit of £20,549 12s. 8d. Out of this sum the following requirements had to be met: Interest on mortgage debt, &c., £5149 4s. 6d.; sinking fund, £4261 18s. 2d.—together, £9411 2s. 8d.—leaving a surplus or net profit for the year of £11,138 10s. This surplus, together with the balance of £5499 8s. 8d. brought from last year's account—making a total of £16,637 18s. 8d.—has been appropriated as follows: Paid to the city fund in aid of rates, £6963 14s. 9d.; placed to the contingent fund, £8521 3s. 11d.; carried to next year's account, £1153. The financial position of the undertaking on March 31, 1896, was as follows:—

Total capital expenditure	£251,689 12 9
Amount of capital redeemed to date	£9,186 4 0
Balance at credit of the renewals account	£7,491 14 9
Do. do. contingent fund	8,521 3 11
Do. do. net revenue account.	1,153 0 0
	£17,165 18 8

The report furnishes particulars as to the additions to the works and mains made and in contemplation; and it concludes by stating that application has been made to the Local Government Board for permission to borrow the further sum of £100,000 for the purpose of carrying out extensions of mains which are imperatively necessary.

PLYMOUTH AND STONEHOUSE GAS COMPANY.

The Annual General Meeting of this Company was held last Thursday—Mr. G. HENDERSON in the chair.

The Directors' report stated that, after payment of the authorized dividend in January last, together with interest on the debenture stock, the balance remaining to the credit of the profit and loss account amounted to £22,047, from which was recommended the payment of a dividend for the half year ended March 31 last of 6½ per cent. on the ordinary stock, 9s. 9d. per share on the "additional shares," and 9s. 3d. per share on the "new shares, Act 1879," free of income-tax. This would absorb £6331; leaving £15,716 to be carried to the credit of the next account. The large gasholder referred to in the last report was completed in time for use during a portion of the past winter, and is working very satisfactorily. Since the previous meeting, an action commenced against the Company by Mr. Ward, whose tannery adjoins the works, had been brought to trial. After the erection of the Company's new retort-house and other works on land bought by the Company at Mr. Ward's suggestion in 1873, he had complained of damage occasioned by dust and smuts alleged to proceed from the Company's works. The Directors had always been most anxious to do everything in their power to prevent any reasonable ground of complaint; and with this view they had been at all times ready to consider any of Mr. Ward's suggestions, and had removed the sulphate of ammonia apparatus to another position, erected a lofty iron screen between the works and Mr. Ward's tannery, placed Colonel Dulier's apparatus in their boiler chimney, and put screens and iron doors to the retort-house, and were now covering over the coke-yard, and making further provision for the escape of dust and smuts. On the trial of the action in London, the Directors, acting on the advice of their eminent Counsel (Sir E. Clarke, Q.C., M.P., Mr. Channell, Q.C., and Mr. Duke), consented to an injunction in terms suggested by them and approved by the Judge, and to the question of damages being referred to the Official Referee. At the inquiry held in Plymouth before the Referee in April last, at which Mr. Ward claimed damages amounting to £6240 18s. 5d., the Directors, again under the advice of Counsel, agreed to the payment of a sum of £3200 in settlement of the amount claimed by Mr. Ward; it being arranged that he should not make any application to the Court to enforce the injunction before Oct. 25 next. This would give time for the completion of the works now in progress, which have been carefully planned by the Consulting Engineer of the Company, and approved by other advisers of the highest eminence, and which the Directors are assured will, when completed, leave no reasonable cause for complaint against the Company's works. In conclusion, the Directors reported, with an expression of regret, the retirement from the Board, through ill-health, of Mr. R. H. H. Snow, the Deputy-Chairman. This reduces the Directors to nine, as provided by the Act of 1894.

The balance-sheet showed that the total capital received is £205,000; and that the Company have still power to issue 5 per cent. stock to the value of £80,000 and to borrow £20,000 of 3 per cent. debentures. During the year ended March 31, the capital outlay amounted to £31,127, of which £937 was for lands, £20,701 for new buildings and plant, and the balance for new mains and services. The revenue account showed a balance of £12,463, as compared with £13,024 in the year ending March 31, 1895. With regard to the profit and loss account, a sum of £23,908 was brought forward; and after paying the interim dividend and deducting the interest on debentures and the bankers' interest, there was a balance of £22,048 remaining on March 31 last. The reserve fund amounted to £17,411. According to the manufacturing account, 68,069 tons of coal and 3343 tons of cannel were carbonized, against 68,800 tons of coal and 1510 tons of cannel in the preceding twelve months. The residuals sold were 35,651 tons of coke, 2058 tons of breeze, 714,120 gallons of tar, and 482 tons of sulphate of ammonia. In the previous year, the sales were 32,258 tons of coke, 2173 tons of breeze, 692,870 gallons of tar, and 541 tons of sulphate.

The CHAIRMAN, in moving the adoption of the report and accounts, said that, owing to the exceptionally mild winter, the working results of the past year had not given the usual increase in their gas-rental. The average annual increase in the output of gas had been 25 million cubic feet, while a particularly severe winter had sent it up to 40 million cubic feet; but for the past year the increase had only been 13 millions. The receipts from sales of gas were £61,044—an increase of £1043 on the previous year. Only £18,315 had been received for residual products, against £21,698 last year; being a decrease of £3383. This was chiefly explained by the reduction in the value of sulphate of ammonia, which only fetched £8 per ton now, as against £12 and £15 per ton a few years ago, while the cost of production remained the same. The total receipts were £83,366, as compared with £85,436 last year—a decrease of £2070. All gas companies throughout the kingdom had suffered more or less from the mildness of the season; and in some cases the consumption of gas was less than in the previous year. As their increase in this respect showed, they were not so badly off as some larger companies. With reference to the litigation between the Company and Mr. Ward, they had received a hint that possibly further proceedings would be taken; and it would therefore be inadvisable and inexpedient to say more upon the subject than appeared in the report. The Directors had done, and were doing, everything possible to prevent a nuisance to Mr. Ward's works; and they had taken every precaution recommended by experts. It was unfortunate for both parties that the works adjoined.

The DEPUTY-CHAIRMAN (Mr. T. Pitts) seconded the motion; and it was carried.

The dividend as recommended was then declared.

The CHAIRMAN next proposed that the Directors be empowered to pay an interim dividend at the same rate on Jan. 1, 1897. He said it was satisfactory that they were able to maintain their dividends with gas at 1s. 9d. per 1000 cubic feet, while they were under the necessity of supplying it at a higher illuminating power than formerly. The only effect of the Corporation's opposition to their Bill in 1894 was that the illuminating power of the gas was raised from 14 to 15 candles. It was impossible for anyone to distinguish between the two; but it had necessitated, on the part of the Company, an additional expenditure, which otherwise might have been devoted to a reduction in the price of gas. The Corporation spent a great deal of the public money in opposing the Company's Bill, and put them also to a large expense, without benefiting either the ratepayers or the shareholders.

The resolution was carried.

The retiring Directors (Mr. G. Cox, Mr. G. Henderson, Mr. J. H. S. May, and Mr. W. Radford) were re-elected; and Mr. J. Pike, the retiring Auditor, was re-appointed.

The meeting was then made special for the purpose of authorizing the issue, under the Company's Act of 1894, of further capital amounting to £15,000 of ordinary stock.

The CHAIRMAN, in moving the formal resolution, explained that they were overdrawn on capital account to the extent of £13,337; and they were also largely overdrawn at their bankers'. He hoped the adoption of this proposal would put them in a position to meet all their liabilities. It was rather an advantage to have an overdrawn account at the present low rate of interest. If they issued new capital, it would involve a much heavier charge in the shape of dividend; so that it was policy to continue the overdraft, so long as the bankers would give them the accommodation they required at 2½ per cent.

Mr. PITTS seconded the resolution; and it was carried.

The CHAIRMAN thanked the shareholders for their attendance, and said he hoped the Company would continue to supply gas at 1s. 9d. per 1000 cubic feet, though it was rather difficult to do so, especially as the extra illuminating power put something like 1½d. or 2d. per 1000 cubic feet on the cost of production, without conferring an appreciable advantage on anyone.

Mr. R. J. BAZLEY proposed a vote of thanks to the Directors for their assiduous attention to the duties of their office.

Mr. R. WOOLLAND seconded the motion, and expressed the hope that the Corporation would in future work more in harmony with the Company than they had done in the past. The Directors were, he said, to be congratulated on the manner in which they guided the Company through the litigation of the past year. They had, however, been put to a great deal of unnecessary trouble by their fellow-townsmen.

The motion having been carried,

Mr. T. WOLFERSTAN, in acknowledging it, said the Directors had certainly experienced considerable anxiety and extra work in consequence of what had occurred in the last twelve months. In connection with what had been said as to the cost of the extra candle of illuminating power, there was a point of considerable importance. When before the Parliamentary Committee, they were told that it depended not so much on the Company as on the consumer whether or not a good light was obtained. It was possible, by the use of regenerative burners, to make the illuminating power of 14-candle gas equal to 24 candles, and by the use of incandescent burners to make it equal to 50 or 60 candles. This showed how useless it was to increase the illuminating power one point by Act of Parliament. When complaints were made about the illuminating power, it was usually less the fault of the gas than of the appliances by which it was consumed.

The CHAIRMAN also briefly acknowledged the resolution.

A vote of thanks was then accorded to the staff, for the efficient manner in which they had performed their duties.

The SECRETARY (Mr. J. Thomas) acknowledged the compliment; and the proceedings closed.

BATLEY CORPORATION GAS SUPPLY.

The Annual Accounts.

We have received a copy of the accounts of the Batley Corporation Gas Department for the year ending March 31 last, prepared by Mr. T. Cantrill, the Borough Accountant. The sale of gas for public and private lighting in the borough and in the township of Soothill produced £17,301; the rental of meters and stoves, £712; residuals (including spent lime and oxide), £3953; and the profit on stores, £34—making a total of £22,000. The manufacture of gas cost £9437 (coals and wages coming to £8403); its distribution, £676; rates came to £1708; and general management and bad debts made up a total of £12,461—leaving a balance of £9539. After meeting the charges for interest and the instalment of the sinking fund, there was left a net balance of £3632, being the profit on the year's working. The balance of accumulated profit on March 31, 1895, was £6797; and £2000 of it was taken to the borough fund in aid of the rates, and £1739 to the contingency fund. The remainder added to the year's profit of £3632 made up £6690 to go to the balance-sheet. At the close of the financial year, the balance of the contingency fund was £8000. The capital account (on which there was an unexpended sum of £7154) was not drawn upon during the year; the outlay on this account being met out of the contingency fund. Under the supervision of Mr. J. F. Bromley, the Engineer and Manager, 16,000 tons of coal and cannel were carbonized in the twelve months covered by the accounts; the quantity of gas made being 161,840,000 cubic feet. Of this, 155,304,000 cubic feet were sold, and 1,009,000 cubic feet were used on the works—the gas unaccounted for being only 3·4 per cent. of the make. The illuminating power averaged 17·94 candles. With regard to price, it is 2s. 3d. per 1000 cubic feet net in the borough, and 2s. 6d. net in Soothill; the charge with automatic meters being 3s. 4d. net. The gas for the public lamps in the borough is charged at the rate of 1s. 6d. per 1000 cubic feet; in Soothill, at 2s. 6d. The average price of the 155,304,000 cubic feet of gas sold last year comes out to 2s. 2·736d. per 1000 cubic feet. The consumers should not have cause of complaint at this; while the ratepayers have received substantial relief out of the profits of the gas undertaking.

ELECTRIC LIGHTING NOTES.

In the opinion of a large section of the ratepayers of Bury St. Edmunds, the Corporation have at present "too many irons in the fire." They have before them what are known locally as the Provision Market and Moyse's Hall schemes, and also a proposal to adopt electric lighting, all of which mean an "extravagant expenditure of the ratepayers' money." The town is already upwards of £50,000 in debt; and if £20,000 is borrowed for electric lighting and £2000 for the other schemes, the total indebtedness will amount to £73,588. These figures were quoted a few days since at a public meeting convened by the Ratepayers' Association, at which resolutions were passed protesting against the proposed expenditure, and declaring that the present is a most inopportune time for the introduction of the electric light. One speaker, referring to the electric lighting project, neatly described the position. It was, he said, a hobby taken up by certain gentlemen with the best intentions; but the townspeople did not want to be landed in heavy debt. The financial success of the electric lighting scheme was doubtful.

The Electric Lighting Committee of the Hull Corporation have adopted a scheme providing for a high tension generating station, with plant equal to 760-horse power, and two sub-stations, with distributing mains, at a cost of £40,679. The annual expenditure, including interest and sinking fund, is estimated at £3786; and the income from a supply of 170,000 units, at 5¼d., at £3895—showing a profit of £109.

Judging from the meagre attendance at the inquiry recently held by Colonel J. O. Hasted into the proposal of the Southampton Corporation to purchase the works of the Electric Light Company, little interest is taken by the ratepayers in the question. The Corporation sought the sanction of the Local Government Board to the borrowing of £50,000 for the purpose. The Company was incorporated in 1888 with a capital of £30,000, only a portion of which, however, had been called up. The amount agreed upon as purchase-money is £21,100, which comprises £19,187 of capital expenditure up to Dec. 31, and a further amount on capital account up to the date of the agreement, together with a certain sum for goodwill. It will be necessary for the Corporation during the ensuing session of Parliament to apply for a Provisional Order to enlarge the undertaking, so as to supply the extended portion of the borough. The witnesses for the Corporation were of opinion that the agreement was fair and equitable; but, in answer to the Inspector, it was stated, on behalf of the Company, that the figure mentioned in the agreement had only been arrived at after very hard bargaining. The Company originally asked for £35,000.

The new Chairman of the Hampstead Electric Lighting Committee is Mr. C. H. Reed, who succeeds Mr. Thwaites after the latter's five years' service. Last Thursday, Mr. Reed reported an increase of 100 customers since Christmas (making 355 in all), and a total present output of current equivalent to 25,292 8-candle lamps through 55 miles of mains. This statement was received with cheers, and the delighted Vestrymen then proceeded to consider a letter from the Westinghouse Company, "claiming a royalty on the three-wire system of supply used by the Vestry, as coming within the claims of the Hopkinson patent; and pressing the Vestry to obtain a licence therefor." In the course of the discussion, the Engineer said he believed the amount of the licence was 2½ per cent. on the cost of the copper; and it was resolved—"That the Vestry do deny any liability in the matter of such patent." On opening the tenders for the extension of the electric lighting station, it was found that that of Messrs. Chessum and Sons, amounting to £7499, was the lowest; while the estimate of the Vestry's Architect was only for £6200. Quite an excited debate ensued on the motion to accept this tender; and several amendments were proposed. But the matter was ultimately smoothed over by the Architect's explanation that his figures were prepared before the late strike, and that since this event all contractors had raised their prices at least 10 per cent. Truly the British Workman is a power in the land! It does not appear to be the intention of the Electric Lighting Committee to formally present to the Vestry their 1895 report, recently detailed in the "JOURNAL." This is wise, for much publication will be saved thereby. The ratepayers are charged 6d. per copy; so few will read it.

The St. Pancras Electric Lighting Committee have chosen for their new Chairman Mr. Edward Cox—a gentleman hitherto associated with the electricity question rather as an opponent than even a lukewarm supporter. When, therefore, this appointment was reported to the Vestry last Wednesday, Mr. M'Gregor moved that the report be referred back for further consideration, and asked why those gentlemen who were capable and willing to act had not been approached. Proceeding to urge the claims of Dr. Smith and Mr. Menzies, the speaker was, amidst some excitement, ruled out of order by the Chairman (Mr. W. J. Wetenhall), who pointed out that the Committee were empowered to elect whom they pleased. Mr. Menzies then expressed regret at his name having been brought forward, and magnanimously declared that he was "perfectly contented with the decision of the Committee." Not so, however, Dr. Smith, who, while agreeing that it would have been better had his name not been mentioned, said that, after being Deputy-Chairman since the Committee was formed seven years ago, he felt that he could not have given satisfaction had the minor office been offered to him again. Thus the incident ended; and whether or not this action of the Committee indicates a change of policy, remains to be seen. A letter was read from the London County Council, offering to lend the Vestry £15,300 for electric lighting purposes, and stating that this would complete the £75,000 sanctioned, and that a further loan could be effected if the details were satisfactory. The Vestry Clerk, commenting on this communication, said that the total only reached £61,400; so that there was still a sum of £3600 to be advanced. Eventually, the whole matter was referred to the Committee for report to the Finance Committee. It is interesting to note that, in his maiden speech as Chairman, Mr. Cox, said it was the policy of his Committee to do their best to prevent accidents. Who need fear explosions now?

The Exeter Corporation have not made a very promising start with the management of the electric lighting undertaking of which they assume control to-day. At a meeting of the City Council last Wednesday, the Electric Lighting Committee submitted a series of recommendations for the conduct of the works. Among their various proposals were: That the Engineer to the old Company (Mr. Munro) be retained at a salary of £200; that the works be considered one of the departments of the work of the Council under the general control of the City Surveyor; that the Council should undertake the installation of the light and the repair of fittings in the houses of consumers; that a staff be appointed, including the present clerk of works as general clerk; and that the accounts be collected by the Corporation rate collectors on a commission of 1½ per cent. All these recommendations were severely criticized. It was said that the carrying out of repairs by corporations resulted in financial loss; that the appointment of Engineer ought to be thrown open; that another and better paid clerk should be appointed, and that he should superintend the collection of the accounts; and that the undertaking should be conducted as a separate department free from the control of the Surveyor and the Town Clerk. Despite the plea of Alderman Domville, who is the Chairman of the Committee, that there was no time to advertise for an engineer, the Council rejected the recommendation for the appointment of Mr. Munro, and decided to throw it open—one gentleman expressing the opinion that they could get the pick of the electrical engineers for a salary of £250. By the casting vote of the Mayor (Alderman R. Pople), it was also decided to advertise for a clerk. How much farther the Council would have gone in their revolt against the Electric Lighting Committee, it is impossible to tell; for at this stage someone discovered that a number of members had gone to lunch, and that there was not a quorum. The rest of the report was accordingly left over for consideration at an adjourned meeting, which was called for yesterday. An attempt was then to be made by the Committee to reverse the decision of last Wednesday's meeting, and to secure the rescinding of the two resolutions passed, and the adoption of the proposals as to the Engineer and the clerk. In any case, it is a bad beginning

WATER SUPPLY BY DISTRICT COUNCILS.

Early in the present session, a Bill was introduced by Colonel Cotton-Jodrell, Sir J. Brunner, and Mr. Tollemache, "to give greater facilities to district councils to arrange with landowners for the supply of pure water to their estates." At present, limited owners and their powers come under the Reservoirs Act, 1877, by which they have authority to carry out the supply by going to land improvement companies, and spending their own money or borrowing it—the sanction of the Board having to be obtained thereto. The present Bill, which consists of seven clauses only, provides that all owners, limited or otherwise, may make arrangements with rural district councils, with the concurrence of the Board of Agriculture. The advantage of the Bill is that in rural parishes it often occurs that a long extension of water-main cannot be supplied without the assistance of the owner, as the rate for carrying out the work would be too heavy a burden for the townships or parishes concerned. The Bill gives power to all owners to charge their estates, or provide the money for this purpose. Under it also, where a long extension of main is contemplated, all owners, large or small, can combine to supply the need, whereas under the Reservoirs Act each individual owner can only act for his own estate. In the case of "partial action"—that is, where only part of a parish or township had to be supplied—the non-receiver of the water would object to the special rate. The Bill does away with this difficulty. The cases where local sewerage works have been opposed by other ratepayers may be cited in support of the above. As an example of the effect of the Bill in a union where its principles have already been applied (by mutual arrangement and by the zeal of the surveyor), about 120 miles of main have been constructed, supplying some 3000 houses, which could not otherwise have been so treated; and applications for the water are still coming in from owners and occupiers all round. The Bill is merely permissive.

THE NIDD WATER-WORKS OF THE BRADFORD CORPORATION.

Last Tuesday, the members of the Bradford Corporation paid a visit to the Gouthwaite compensation reservoir, which is being constructed in connection with the new water-works in the Nidd Valley. On arrival, the party were driven in carriages to the lower end of the site of the reservoir, about 2 miles above Pateley Bridge. The works in connection with the great dam which is to stop up the end of the Nidd Valley, and so form the Gouthwaite reservoir, more than two miles in length, were inspected with much interest. The maximum depth of this dam is 110 feet; and its maximum width at the base is 74 feet. It will take at least two more years to complete. The River Nidd has been diverted to a course near the road to Gouthwaite Hall; and from here to the rising ground opposite, extends an immense trench above 100 feet deep, in which the solid masonry dam is being slowly erected. From this part of the work the party were driven to Ramsgill, which will be at the head of the reservoir, and thence to How Stean Beck and Middlesmoor. At various points on the west of this route, high up the hillside, could be seen the works necessitated by the construction of the conduit, which starts at Woodale, above Middlesmoor. The Corporation have obtained powers for erecting three service reservoirs above Woodale; but at present they are contenting themselves with partially tapping the water supply there, and absorbing a large number of streams below, which intercept the conduit to the west of the Gouthwaite site. Without building a single storage reservoir, the Corporation, by a comparatively small dam at Woodale, and by the line of conduit below, will gather upwards of 4 million gallons of water a day; but the undertaking is of such an elastic character that, under the powers already acquired, they will be able to extend it from time to time, as occasion may necessitate. On returning to Pateley Bridge, the party dined at the King's Arms Hotel; Alderman Holdsworth, the Chairman of the Water Committee, presiding. Responding to the toast of "The Water Committee," the Chairman remarked that as Bradford had spent more than three

millions of money on water-works, and would spend £140,000 or £150,000 a year for some time to come, it could not be said that the Corporation were lacking in the enterprise and forethought necessary for providing the town and trade of the district with an adequate supply of water. Next to wool, perhaps water was most essential to the Bradford trade; and the Corporation were trying not only to supply this water in sufficient quantity, but of the quality which was necessary to enable local manufacturers to compete with those of France and other countries. The construction of the new water-works was not the only difficult aspect of the undertaking. In the acquisition of land and rights, the Committee had to fight a good many extravagant claims. The Corporation, recognizing the compulsory character of their action, had been prepared to pay liberally for anything they took from other people; but they had been obliged not to confuse liberality with extravagance, and confine their transactions to such as were fair and just from the point of view of the ratepayers.

LEIGHTON BUZZARD WATER SUPPLY.

Local Government Board Inquiry.

The Leighton Buzzard District Council having applied to the Local Government Board for powers to borrow a further sum of £2500 for the purpose of completing the water-works, Colonel A. G. Durnford, R.E., recently held an official inquiry in regard to the matter. Mr. J. Newton, the clerk to the Council, said the original estimate had been exceeded by £2500, which occurred as follows: The water-tower and engine-house were put down to cost £2138; and the expenditure amounted to £4178; for pumping and gas-engines in duplicate, the expenditure had exceeded the estimate by £85; the well, 8 feet in diameter, cast-iron cylinders, and bore-hole, cost £254 more than was reckoned for; while the engineer's charges and superintendence by the clerk of the works had amounted to £120 more than was given in the estimate. Mr. H. B. Nichols, the Council's Engineer, explained that the excess was caused by the combining of a water supply scheme and a sewerage scheme. The Inspector asked if payment had been made out of one fund; because it was represented that the excess was on the water supply. Mr. Nichols said the excess was due to both schemes. The Inspector said the question of mixing the water and sewerage matters appeared to him to be one of account. What he really wanted to know was what had caused the excess; and he had it that it was the water supply. If Mr. Nichols could keep the sewerage works out of it, he hoped he would do so. Mr. Nichols said he thought he could divide the work as suggested. He was proceeding to explain the cause of the excess, when the Inspector said it was now clear to him that the required loan was for the combined works. He would take the whole thing as it stood, though he did not know whether the Local Government Board would not object to lend the money, as the inquiry had not been called to take into account the sewerage works. It appeared that the price of the bricks used influenced the whole of the items of excess over the estimate. All the estimates were prepared four years before the tenders were invited; and, in the meantime, materials of all description had gone up in price. After examining the figures put before him, the Inspector said there had been an excess over the estimate on the sewerage works of £1505; while that on the water-works was £2359—making a total of £3864, which, with fees common to both works, brought up the total to £4394. He promised to make his report to the Local Government Board as soon as possible.

New Gas-Works for Southborough.—The Southborough District Council have resolved to erect new gas-works from plans prepared by Mr. Corbet Woodall, M.Inst.C.E.; and they have secured land for the purpose at Liptraps Farm.

Proposed Water-Works for Wrotham.—At a meeting of the Wrotham District Council last Wednesday week, Mr. Terry proposed that application be made to the Local Government Board for powers of water supply under the Public Health Act. It was suggested that the Council should construct water-works which will provide a supply for Wrotham, Borough Green, Platt, and Ightham at a cost of about £5000; and the proposition was agreed to.

Assessment Appeal by the Sheppy Gas Company.—At the meeting of the Sheppy Union Assessment Committee at Minster last Wednesday, Mr. A. W. Marks, the Secretary of the Sheppy Gas Company, attended to appeal against the action of the Overseers of Queenborough in raising the rating of the gas-mains in the borough from £50 to £89. Mr. Marks said there had been no increase of plant or in trade receipts; and the Company considered that the alteration was altogether unwarrantable. The assessment was fixed in 1880 when the Company's tender for the borough lighting was £485 17s., as compared with £555 15s. 7d. at the present time. The assessment was reduced to £65.

Proposed New Reservoirs for Leeds.—At a recent meeting of the Leeds Corporation Water Committee, a Sub-Committee reported the result of their negotiations with the owners of various properties at the head-waters of the Washburn, where land is required as the site of a proposed new high-level storage reservoir for the city; but they were not able to make any definite recommendation on the subject. The new reservoir is intended to supply the higher districts by gravitation, as the cost of pumping is becoming a serious item of expenditure. It was also reported that, as the result of an interview with the Local Government Board officials, the permission previously given to the Corporation to construct a service reservoir on land belonging to the Low Moor Company at Harehills, had been transferred to a site belonging to Earl Cowper. The City Engineer (Mr. T. Hewson) was instructed to obtain tenders for the work. The Committee decided to ask the Local Government Board for power to borrow a further sum of £50,000 in connection with various works at present in hand.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

I have now received the annual accounts of the Edinburgh and Leith Gas Commission. The total revenue was £232,326, which is £13,405 less than it was in the year 1894-5, and £15,938 less than two years ago. The total revenue from the sale of gas was £211,339, which was £7552 less than in 1894-5, and £13,643 less than two years ago. These decreases in revenue are not accounted for by falling off of business; for last year the quantity of gas sold amounted to 1,424,231,400 cubic feet, which was an increase of 49,240,400 cubic feet upon the year preceding, and of 153,088,400 cubic feet upon the sale reported two years ago. Coke last year realized £5541, which was £1010 less than a year ago, and £363 more than two years ago. Tar and ammoniacal liquor produced £15,000, which was £4829 less than a year ago, and £2905 less than two years ago. These two decreases amount together to £5839, or nearly half of the decrease in the total revenue. The remainder of the decrease is due to the fact that last October the price of gas was reduced by 2d. per 1000 feet. The total expenditure amounted to £193,522; leaving a balance to be carried to profit and loss account of £38,803. The quantity of coal carbonized was 151,117 tons (costing £88,044), as compared with 141,531 tons (costing £90,896) in the year 1894-95, and 131,980 tons (costing £87,737) in the year preceding that. These figures show how the prices of coal have been going. Nearly 20,000 tons of coal more were got last year for almost the same outlay as two years ago. The total cost of the manufacture of gas last year was £146,036, which was £2648 more than in the preceding year, and £7168 more than two years ago. Distribution cost £23,560, which was £4747 more than a year ago, and £2201 more than two years ago. Management expenses were £7557, which was £346 more than a year ago, and £832 more than two years ago. Feu duties, rates, and taxes amounted to £10,376, which was an increase of £109 over the preceding year, and of £3042 over the year before that. The other items vary but little. It will be observed that, for the year just closed, the net surplus on the working is only £102. Twelve months ago, it amounted to £13,046; and for the year before that, to £19,641. I make no comment on the small balance. This is a question of finance; and it is looked upon rather as a matter for satisfaction than otherwise, that the balance should be small. It must not be forgotten, however, that the Commissioners have, since October, been working against the estimate of Mr. Gibb, their Treasurer, because his estimate was that the net cost of gas would be 3s. ½d. per 1000 feet; whereas the Commissioners, rather than impose a ½d., or make more than the estimate by raising the price to 3s. 1d., lowered the charge to 3s.—thereby standing to lose ½d. per 1000 cubic feet. This circumstance accounts for the fact that this year the sums set apart, in terms of the statute, for repayment of borrowed money and redemption of annuities—amounting together to £8521—is charged out of the sum at the credit of profit and loss account brought forward last year. The Commissioners made too much money in the years 1893-94 and 1894-95. They have now, for a year, gone the other way; but their finances are thoroughly sound, as they have still a balance of £38,613 at the credit of the profit and loss account, besides £72,298 of sinking funds, and a reserve fund of £3000. The capital account, however, requires to be adjusted, as I observe that the current account has been overdrawn during the year by over £35,000. Owing to this circumstance, I do not, until I see what is proposed, say anything about the capital account. The gas-stove account rises slowly. The total receipts under this head amounted to £1226, as compared with £1096 a year ago. For the hire of stoves, the amount was £655, as against £600; and for stoves sold the amount received was £364, as compared with £285. It is intimated that a Sub-Committee of the Works Committee have recommended the introduction of penny-in-the-slot meters into the poorer quarters of the city, including one and two roomed houses which the Corporation are building.

The proposal for the extension of Edinburgh by the inclusion of Leith and Portobello having failed in regard to Leith, but succeeded so far as Portobello is concerned, a curious question has arisen as to the position which will be occupied by the Portobello Gas Company. By their Act of 1888, the Corporations of Edinburgh and Leith undertook the joint ownership of the gas undertaking; and the burgh of Portobello was expressly excluded from the area of supply. Now that Portobello is to be amalgamated with Edinburgh, it is necessary, in order to make the amalgamation complete, that the Portobello Gas Company should be bought up by the Corporation of Edinburgh. An agreement on the subject has been come to between the Corporation and the Company; but there is dissatisfaction in Leith. Provost Bennet, of Leith, has given notice that he will, at the next meeting of the Edinburgh and Leith Gas Committee, draw the attention of the Commissioners to the intended purchase by the Corporation of Edinburgh of the Portobello Gas Company, under the relative agreement scheduled to the Edinburgh Extension Bill, and ask the Chairman why the Commission did not oppose such intended power of purchase, in so far as the same is an infraction of the agreement arrived at between the Corporations of Edinburgh and Leith, as embodied in the Edinburgh and Leith Corporations' Gas Act of 1888. In the event of the answer not being deemed satisfactory, he will move that the Commission ought to have so opposed the intended purchase. This looks like a little storm in a teapot. So long as there is no proposal by the Corporation of Edinburgh to supply gas in Portobello at less than cost price, the interests of Leith cannot be prejudiced. Whenever this should happen, it will be open to the Gas Committee to give the supply; and it will then be for the Corporation of Leith to see that, if there should be any deficit, it be made up by the Corporation of Edinburgh. There the matter should end.

With experience comes knowledge. I mentioned last week the difficulty which had been raised about the quantity of concrete which should be used in the foundation of the new wire-rope guided gas-holder which is about to be erected by the Perth Gas Commission. The original specification was for a bed 3 feet in thickness; while some thought that 18 inches would be sufficient. The matter was submitted to Messrs. Ashmore, Benson, Pease, and Co., the contractors, for their opinion. The firm, proceeding, according to all appearance,

upon the experience they have had with the large holder which they have erected at Middlesbrough, upon similarly low-lying ground, have advised that the whole of a bed of sand which lies above the gravel should be excavated, and that then the bed of concrete should be 12 inches thick. The holder would thus be sunk some way into the ground; and the outside could be protected by a thin layer of asphalte between the wall and the surrounding soil. This recommendation was agreed to at a special meeting of the Commissioners on Monday.

The shareholders of the Dumfermline Gaslight Company, which, by the way has been in existence since 1828, held what, in all probability, will be their last annual meeting on Wednesday. In the course of their report, the Directors said: "As the shareholders are aware, the Corporation of Dumfermline some time ago adopted the Burghs Gas Supply (Scotland) Act, 1876, and gave notice to the Company of their wish to acquire the undertaking by private bargain, or by arbitration under the Lands Clauses Act. The shareholders authorized the Directors to receive and consider any private offer which the Corporation might make, and failing the receipt of an offer, to enter upon an arbitration. The Corporation recently informed the Directors that they have resolved not to make a private offer, and that they desire to proceed by arbitration. The Directors are accordingly making arrangements on the part of the Company; and it is probable that the undertaking may be transferred from the Company to the Corporation within the next few months." The details of the balance-sheet will come out in the arbitration proceedings.

The Bothwell and Uddingston Gas Company, which is managed by Mr. L. Hislop, held their annual meeting on Monday. During the year, £2539 was expended in the erection of a new retort-house and governor-house, the provision of a new governor, and the extension of mains. In consequence, the capital of the Company has been increased from £13,500 to £15,750. Further extensions are contemplated —chiefly in the erection of a new purifier-house, to contain four purifiers, 20 feet square, provided with Weck's patent centre-valve. The whole of these extensions, it may be said, have been designed by Mr. Hislop, and their construction supervised by him. The necessity for work is shown by the output of gas having risen during the year from 26½ million to about 28½ million cubic feet. While the output has increased, the leakage has been reduced from 7·6 to 5·4 per cent. I observe that about 200 cubic feet more of gas per ton of coal has been obtained; but I expect that the new settings of retorts will yield still better results. The revenue amounted to £5814, of which £4637 was derived from the sale of gas, and £1041 from residuals, as compared with £4344 from gas, and £883 from residuals in the preceding year. The balance at the credit of profit and loss account, after charging renewals and bad debts, amounted to £1686. A sum of £320 has been written off for depreciation, a dividend at the rate of 10 per cent. has been paid, and £289 has been added to the reserve fund, which now stands at £4799. The report was adopted; and Mr. Hislop was thanked, along with the Directors, for the results which had been obtained.

The affairs of a few Gas Companies call for brief notice. The Kelso Gas Company held their annual meeting last Wednesday. It was reported that, notwithstanding heavy expenditure in laying down new mains, &c., the funds of the Company were in a healthy condition; and the usual dividend of 10 per cent. was paid. The price of gas remains at 4s. 7d. per 1000 cubic feet. The Jedburgh Gas Company also met on Wednesday. The profits for the year amounted to £396. On account of the reduction in the price of gas, the revenue of the Company was £96 less than in the previous year; but there was also a reduction of expenditure. A dividend at the rate of 6¼ per cent. was paid; and £50 was added to the depreciation fund. The Hawick Gas Company's profit for the past year amounts to £1711. It is proposed to retain the price of gas at 3s. 6½d. per 1000 cubic feet for this year. The Dunoon Gas Company have closed the most prosperous year in their history; there having been an increased output of gas to the amount of 2,223,000 cubic feet. They have reduced the price of gas from 5s. to 4s. 7d. per 1000 cubic feet. The Muirkirk Gas Company have paid a dividend at the rate of 7½ per cent., and added £62 to the reserve fund. The Earlston Gaslight Company had a large increase in the output of gas last year; and the revenue was greater, notwithstanding that the price of gas was reduced. By the new setting of retorts, a larger quantity of coke is available for sale; and altogether the Company are in a prosperous condition. A dividend at the rate of 7½ per cent. has been paid.

The employees in the Dundee Corporation Gas Department enjoyed their annual excursion on Thursday. The place visited was the popular Monikie Water-Works, belonging to the Corporation. Mr. J. M'Crae, the Engineer and Manager, was present; and his happy nature led enjoyment at a high pace.

A conference of Scottish District Councils in connection with the movement for a national registration of plumbers has been held in Edinburgh this week, along with which there was an exhibition of sanitary appliances. Both the exhibition and the proceedings leant to the sanitary side of the plumber's craft. Perhaps the most important item of business they transacted, was a resolution to petition Parliament for the insertion of a clause in the Public Health (Scotland) Bill, granting power to local authorities, or to the Local Government Board, to frame plumbing regulations. To-day has been set apart for sight-seeing. Among other places visited, were the Edinburgh Gas-Works and the works of Messrs. James Milne and Son, Limited. At the latter place they were received by Mr. James Milne, the Managing Director, Mr. D. Macfie, Mr. Lumsden, and Mr. Oliver. A long inspection of the works—which include brass-founding, meter-making, and engineering—was made, at the conclusion of which one delegate remarked that he had no idea so much work in that line, from start to finish, was done by any firm out of Birmingham. The party were entertained by the firm, after which Mr. Milne expressed the pleasure it had given him and his co-Directors to have them there, and show them all that they were doing. Mr. Macfie reminded the company that the firm of James Milne and Son dated back to 1750; and that Mr. Milne was the fifth of the family in succession who had been at the head of the firm, while his son—the sixth—was at present employed in the works.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST (see ante, p. 1459).

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	15 Apl.	10½	Alliance & Dublin 10 p. c.	25—26	..	4 0 9
100,000	10	,,	7½	Do. 7 p. c.	17—18	..	4 3 4
300,000	100	2 Jan.	5	Australian (Sydney) 5% Deb.	110—112	..	4 9 3
209,000	10	12 June	5	Belgrano (B. Ayres), Limited	9—10	..	5 0 0
100,000	Stck.	26 June	5	Do. 5 p. c. Deb. Stk	100—103*	+1½	4 17 1
200,000	5	29 May	6¼	Bombay, Limited	7¼—7¾	..	4 3 10
40,000	5	,,	6¼	Do. New, £4 paid	5¾—6	..	4 6 8
380,000	Stck.	27 Feb.	12	Brentford Consolidated	290—295	..	4 1 4
210,000	,,	,,	9	Do. New	220—225	..	4 0 0
50,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
159,375	,,	12 June	4	Do. 4 p. c. Deb. Stock.	130—134	..	2 19 9
220,000	Stck.	27 Mar.	11	Brighton & Hove Original	237—242	..	4 10 11
208,820	,,	,,	8	Do. A Ord. Stk.	190—195	..	4 2 0
933,500	Stck.	27 Feb.	5	Bristol, 5 p.c. max.	127—132	..	3 15 9
420,000	20	27 Mar.	11¼	British	56¼—57¼	+¼	3 18 3
50,000	10	12 Mar.	11¼	Bromley, Ordinary 10 p. c.	22¾—23¾	..	4 17 11
71,000	10	,,	8½	Do. 7 p. c.	19—20	..	4 5 0
500,000	10	29 Apl.	5	Buenos Ayres (New) Limited	9¾—10¼	+¼	4 15 3
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	103—105	..	5 14 3
150,000	20	27 Feb.	8¼	Cagliari, Limited	29—31	..	5 6 5
100,000	10	29 May	8	Cape Town & District, Ltd.	17—18	..	4 8 11
50,000	50	2 May	6	Do. 6 p. c. 1st Mort.	58—60	..	5 0 0
550,000	Stck.	15 Apl.	13¾	Commercial Old Stock	342—347	..	3 17 8
165,000	,,	,,	10¾	Do. New do.	258—263	..	2 19 10
165,000	,,	12 June	4¾	Do. 4½ p. c. Deb. do.	146—150	..	3 0 0
800,000	Stck	12 June	13	Continental Union, Limited.	285—290	..	4 9 8
200,000	,,	,,	10	Do. 7 p. c. Pref.	217—222	..	4 10 1
51,600	Stck.	27 Feb.	14	Croydon Com'cial A 10 p. c.	—	..	—
157,500	,,	,,	11	Do. B 7 p. c.	—	..	—
535,000	Stck.	27 Feb.	5¼	Crystal Palace Ord. 5 p.c. Stk	135—140	..	3 15 0
60,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
486,090	10	30 Jan.	11	European, Limited	26¾—27½	..	4 0 0
354,060	10	,,	11	Do. £7 10s. paid	17½—18½	..	4 9 3
5,746,590	Stck.	13 Feb.	12¾	Gaslight & Coke, A, Ordinary	312—316	+1½	4 0 8
100,000	,,	,,	4	Do. B, 4 p. c. max.	108—113	..	3 10 9
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	297—302	..	3 6 3
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	145—150	..	3 6 8
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	210—215	..	3 9 9
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	205—210	..	3 6 8
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	295—300	..	3 6 8
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	172—177	..	3 7 10
1,061,150	,,	12 June	4	Do. 4 p. c. Deb. Stk.	138—143	..	2 15 11
294,850	,,	,,	4½	Do. 4½ p. c. do.	148—153	..	2 18 9
908,000	,,	,,	6	Do. 6 p. c. do.	205—209	+2	2 17 5
70,000	10	14 May	6	Hongkong & China, Limited	12¾—13½	..	4 8 10
3,800,000	Stck.	14 May	12	Imperial Continental	248—252	..	4 15 3
376,400	100	1 Feb.	4	Do. 4 p. c. Debs. Red.	100—103	..	3 17 8
473,600	Stck.	13 Feb.	3½	Do. 3½ p. c. Deb. Stk	109—111	..	3 3 1

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	26 June	6	Malta & Mediterranean, Ltd.	6—6½*	..	4 12 4
560,000	100	1 Apl.	5	Met. of Melbourne, 5 p. c. Deb.	115—118	..	4 4 10
250,000	100	,,	4½	Do. 4½ p. c. Debs.	110—112	..	4 0 4
541,920	20	12 June	5	Monte Video, Limited	16½—17½	..	5 14 3
150,000	5	29 May	8	Oriental, Limited	8½—8¾	..	4 11 5
135,000	5	,,	8	Do. New, £4 10s. paid	7¼—7¾	..	4 12 10
15,000	5	,,	8	Do. do. 1879, £1 paid	1—2	..	4 0 0
60,000	5	12 Mar.	7	Ottoman, Limited	5—5¼	..	6 7 3
166,870	10	—	2	Para, Limited	1¼—1½	..	—
420,000	100	2 Nov.	6	People's Gas } 1st Mtg. Bds.	105—110	..	5 9 1
500,000	100	1 June	6	of Chicago } 2nd Do.	102—107	..	5 12 1
250,000	10	27 Mar.	8	San Paulo, Limited	13—14	..	5 14 3
500,000	Stck.	13 Feb.	15½	South Metropolitan, A Stock	405—415	..	3 14 8
1,350,000	,,	,,	12	Do. B do.	315—320	..	3 15 0
310,000	,,	,,	13	Do. C do.	337—342	..	3 16 0
800,000	,,	16 Jan.	5	Do. 5 p. c. Deb. Stk.	175—178	..	2 16 2
60,000	Stck.	12 Mar.	11½	Tottenham & Edmonton, A	250—255	..	4 10 2
60,000	,,	,,	8½	Do. B	—	..	—
170,380	10	29 May	10	Tuscan, Limited	13½—14½	..	6 18 0
149,900	10	2 Jan.	5	Do. 5 p. c. Debs. Red.	100—102	..	4 18 0

				WATER COMPANIES.			
746,123	Stck.	26 June	10¾	Chelsea, Ordinary	343—348*	+1	2 18 11
150,000	,,	,,	5	Do. 5 p. c. Pref.	170—175*	+½	2 17 1
160,000	,,	,,	4½	Do. 4½ p. c. Pref. Stk., 1875	—	..	—
175,785	,,	27 Mar.	4½	Do. 4½ p. c. Deb. Stock	158—163	..	2 15 2
1,719,514	Stck.	15 Apl.	7	East London, Ordinary	243—248	..	2 16 6
654,740	,,	26 June	4½	Do. 4½ p. c. Deb. Stk.	156—159*	+½	2 16 7
100,000	,,	,,	3	Do. 3 p. c. Deb. Stk.	104—106*	+½	2 16 7
700,000	50	12 June	7½	Grand Junction, 10 p.c. max.	125—130	..	2 17 8
280,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	149—153	..	2 12 4
708,000	Stck.	13 Feb.	12	Kent	348—353	..	3 8 0
160,000	,,	,,	7	Do. New, 7 p. c. max.	215—220	..	3 3 7
1,043,800	100	26 June	7½	Lambeth, 10 p. c. max.	272—275*	—½	2 14 6
406,200	100	,,	7½	Do. 7½ p. c. max.	227—230*	+2½	3 5 2
350,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	147—152	..	2 12 8
500,000	100	13 Feb.	12¾	New River, New Shares	435—440	..	2 18 0
1,000,000	Stck.	30 Jan.	4	Do. 4 p. c. Deb. Stk.	154—159	..	2 10 4
902,300	Stck.	12 June	4	S'thwk & V'xhall, Ordinary	165—170	..	2 7 1
126,500	100	,,	4	Do. Do. 7½ p. c. Max.	153—163	..	2 9 1
489,200	Stck.	,,	5	Do. Do. 5 p. c. Pref.	165—170	..	2 18 10
1,019,585	,,	15 Apl.	4	Do. 4 p. c. A Deb. Stk.	147—152	..	2 12 8
1,155,066	Stck.	12 June	10	West Middlesex	322—327	..	3 1 2
200,000	,,	,,	4½	Do. 4½ p. c. Deb. Stk.	155—160	..	2 16 3

*Ex div.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June 27.*

Sulphate of Ammonia.—There is no new feature this week in the market, which remains *in statu quo*. The demand has been somewhat light—the needs of the speculators, which are generally manifested at this period of the month, not having been as considerable as it was anticipated they would be. But, on the other hand, the quantities offered by makers have been small. Values are steadily maintained at £7 18s. 9d. to £8 Leith, and £8 to £8 2s. 6d. Hull and Liverpool. For forward delivery, there are makers who are still willing to sell for delivery at Leith up to June next at prices last quoted; but even these apparently low values do not tempt buyers, who meantime maintain an attitude of reserve.

Nitrate of Soda is unchanged at 7s. 9d. to 7s. 10½d., according to quality.

LONDON, *June 27.*

Tar Products.—This market is firmer all round, perhaps with the exception of pitch, which hangs fire at reduced prices. A steady business is being done in benzols; and a fair inquiry for forward delivery exists. Both carbolic and cresylic acid are moving off more freely, and accumulated stocks are being reduced. A better tone pervades the market for common tar oils; and prices have a tendency to harden. Anthracene is held in strong hands; and, although efforts are being made to reduce prices, they so far have been only partially successful. Makers are well sold, and are quite easy and indifferent to the operations of buyers to lower prices. A good deal of comment has been passed on the high prices which have been paid in one or two instances for tar contracts; and it is generally felt that the buyers will burn their fingers.

Prices prevailing during the week are: Tar, 18s. to 24s. Pitch, nominal, 30s. to 32s. 6d. Benzols, 90's, 2s. 8d. to 2s. 9d.; 50's, 2s. 3d. to 2s. 4½d. Toluol, 1s. 10d. Solvent naphtha, 1s. 3d. Crude, 30 per cent., naphtha, 10½d. Creosote, 1½d. Naphthalene, pressed, £3; salts, 35s. Cresylic acid, 1s. Carbolic 60's, 2s. Anthracene, "A," 11d; "B," 8d. to 9d.

Sulphate of Ammonia is undoubtedly stronger; and there are numerous buyers at prices ranging at all ports from £8 to £8 2s. 6d. per ton, less 3½ per cent. discount. Gas liquor is quoted 6s. 6d. to 7s.

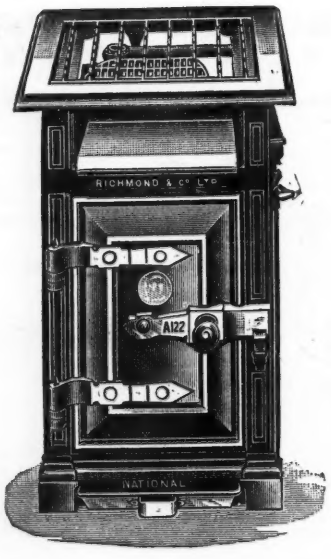
The Use of Gas for Cooking Purposes at Heywood.—At a gas exhibition, held in the Heywood Reform Club last week, Mr. A. C. Maden, Chairman of the Gas Committee of the Corporation, gave some particulars as to increasing use of gas for cooking purposes in the borough. He said that in 1886 there were 120 gas stoves, grillers, &c., in operation in the town; and now there were 953. They had 4600 gas consumers in the borough, and those who employed gas for cooking purposes were about 20 per cent. of the whole.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—A few of the smaller gas-coal contracts have been settled during the last week or so; and from what transpired as to the prices, they have in most cases been cut extremely low. Colliery proprietors, who last year were content to take the exceptionally low prices that were then ruling, as a temporary matter only, but are this year holding out for some more remunerative return, have been altogether out of competition. In fact, in some instances, they have been written to as to whether they have not really made some mistake in their quotation, as they have been so far above those which have been sent in from other collieries. Ordinary Wigan four-feet gas coal would seem to have been bought at about 6s. to 6s. 3d. per ton; and for ordinary screened Wigan Arley gas coals, about 6s. 9d. to 7s. is, in some instances, being taken. These figures represent an even more substantial reduction on last year's rates than previously referred to. They may, however, be taken as somewhat exceptional; and from what can be gathered, about 3d. per ton would still in most cases seem to represent about the extent of the reduction upon last season's prices. A depressed tone still prevails in the general coal trade; the only direction in which there is any activity being in the demand for engine fuel. House-fire coals continue in very slow request; and even with pits only working three to four days per week, stocks are accumulating. Although list rates are nominally unaltered, prices are weak where actual business is concerned; and concessions are frequently made to effect clearances. The lower descriptions of round coals meet with a fair sale, for iron-making, steam, and general manufacturing purposes; but supplies are excessive, and prices are cut very low. As regards engine fuel, the limited quantity now offering moves away readily; and prices show a continued hardening tendency—an advance of 3d. per ton upon late rates being generally got without difficulty. At the pit mouth, best Wigan Arley averages 9s. 6d. to 10s. per ton; Pemberton four-feet and seconds Arley, 8s. to 8s. 6d.; common house coal, 6s. 6d. to 7s.; steam and forge qualities, 5s. 6d. to 6s; common slack, 3s. 3d. to 3s. 9d; and better sorts, 4s. 6d. to 5s. Rather more active business is reported in the shipping trade; principally in the medium house fire qualities for Ireland, which average from 8s. 3d. to 8s. 6d. up to 9s. per ton, delivered at the ports on the Mersey. The demand for steam coal, however, continues slack; and no better prices are obtainable. Ordinary qualities, delivered at the Garston Docks or the High Level, Liverpool, do not average more than 7s. per ton.

Scotch Coal Trade.—The outlook is, if anything, less satisfactory. Sellers are pressing business, though sticking to current prices; and purchasers are slow to take up at the rates asked. Both classes seem to be in a waiting mood, in the expectation of something occurring in England in the autumn, when the Rosebery agreement terminates, which will bring them relief. The prices quoted are the same as they



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have been for some time past—viz., main, 5s. 9d. (easy) per ton f.o.b. Glasgow; ell, 6s. 3d. to 6s. 9d.; splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. The shipments for the week amounted to 149,584 tons—a decrease of 20,821 tons on the preceding week, and of 4576 tons when compared with the corresponding period of last year. For the year to date, the total shipments have amounted to 3,404,610 tons—a decrease of 220,196 tons on the corresponding period of last year.

Northern Coal Trade.—The past week has had the interruption to production of coal which is usually brought by the race holidays at Newcastle; and fuel has been temporarily scarce. It is, however, now in more abundant production; though the prices have been steadied by the scarcity. Best Northumbrian steam coals are quoted at 8s. 3d. to 8s. 6d. per ton f.o.b; and for second-classes about 7s. 9d. per ton is the prevailing price. Steam smalls are more plentiful at about 3s. 6d. per ton; while the demand may be said to be very good all round, and the collieries are well employed. In the manufacturing coal trade, business is only very moderate at present; and the prices are this week absolutely without change. In gas coal, it is noticeable that the chief local gas company are now inviting tenders for their supply to commence next year; a step which is taken by some as a proof that rather better prices are expected to prevail at the time when these tenders are usually invited—in the early part of the winter. At the present time, the price that prevails for best Durham gas coals may be given as generally from 6s. 6d. to 6s. 9d. per ton f.o.b. In coke, the local demand is very large, and it takes up the bulk of the output, which is far above the average; and that the decrease in the shipments is only very slightly felt. In the gas coke trade, there is still dulness, and the price is weak; but the production continues very limited, and this is a support to the market. There is some slight apprehension as to labour difficulties in the coal trade at the termination of the Conciliation Board; and this may induce a larger stocking of coal next month, when the supplies will be very plentiful, even if there should be an increased demand.

The Water Scheme of the London County Council.—At the meeting of the London County Council last Tuesday, the Finance Committee reported that on the 19th ult. the Council passed a resolution referring it to the Committee to report, at as early a date as possible, what effect the carrying out of the scheme as to the sources of a supplementary supply of water would have on the rates of London. The Committee had carefully considered this reference, and felt that it would be quite impossible for them at present, under all the circumstances, to give any opinion as to the effect on the rates of carrying out the scheme in question. They therefore recommended that the reference be discharged. This was agreed to without comment.

Entertainment at the Port Elizabeth Gas-Works.—With the view of honouring the Queen's Birthday, the Manager of the Port Elizabeth Gas-Works (Mr. W. Arnott) organized an evening entertainment in the new store-room at the works. A varied programme was provided, which was gone through to the gratification of a gathering of about a hundred of the employees and their wives and friends. Light refreshments were served during the evening. Apart from patriotic considerations, Mr. Arnott was actuated by a very commendable desire to promote a feeling of loyalty and good-fellowship among his men; and, in the course of a few well-chosen remarks, he explained that he intended the entertainment to be an annual institution, which he trusted would be a means of binding men and masters more together.

Exhibition of Gas Appliances at Coventry.—On Monday last week, Messrs. Richmond and Co., Limited, opened their third exhibition of gas cooking and heating stoves in the Corn Exchange, Coventry; the inaugural ceremony being performed by the Mayor (Alderman Loudon). Miss Lillie Richmond gave practical lectures on cookery.

Sales of Shares.—A parcel of 150 "D" £20 shares in the Weston-super-Mare Gas Company have lately been sold by auction at £34 15s. to £35 10s.; the total sum realized being £5255.——Several £10 shares in the Sandwich Gas Company (paying 6 per cent.) lately changed hands at £10 each; and £10,000 of 4 per cent. debenture stock of the West Ham Gas Company realized £12,621.

Proposed Purchase of the Ashford Gas-Works by the Local Authority.—The Ashford District Council have definitely decided to take steps to acquire the Ashford Gas Company's undertaking, and have requested the Directors to confer with them on the matter. In the event of no arrangement being arrived at, the Council will promote a Bill in Parliament to enable them to carry out their resolution.

The Wells Town Council and the Gas Company.—A special meeting of the Wells Town Council was held on the 19th inst., for the purpose of receiving a communication from the Gas Company, in which they declined to quote terms on the lighting of the city for twelve months until the negotiations for the purchase of their property were at an end. The letter gave rise to a long and animated discussion. The advocates of purchase justified the Company in not naming terms until negotiations had really ended, on the ground that these had taken place on the basis of the price of gas being 3s. 9d. per 1000 cubic feet, and notice had been given of the Company's intention to reduce the charge to 3s. 6d. if the Council did not buy. Those who favoured the electric light considered that the fact of the Company being asked for terms for lighting for one year only was equivalent to a notice, and the negotiations were at an end. It was moved that the Council purchase the works for £17,400, and pay the whole of the costs of the necessary Act of Parliament; but an amendment was subsequently proposed that the Company be informed that the negotiations for purchase were closed. On a division the voting was equal, whereupon the Mayor gave his casting vote for the amendment.

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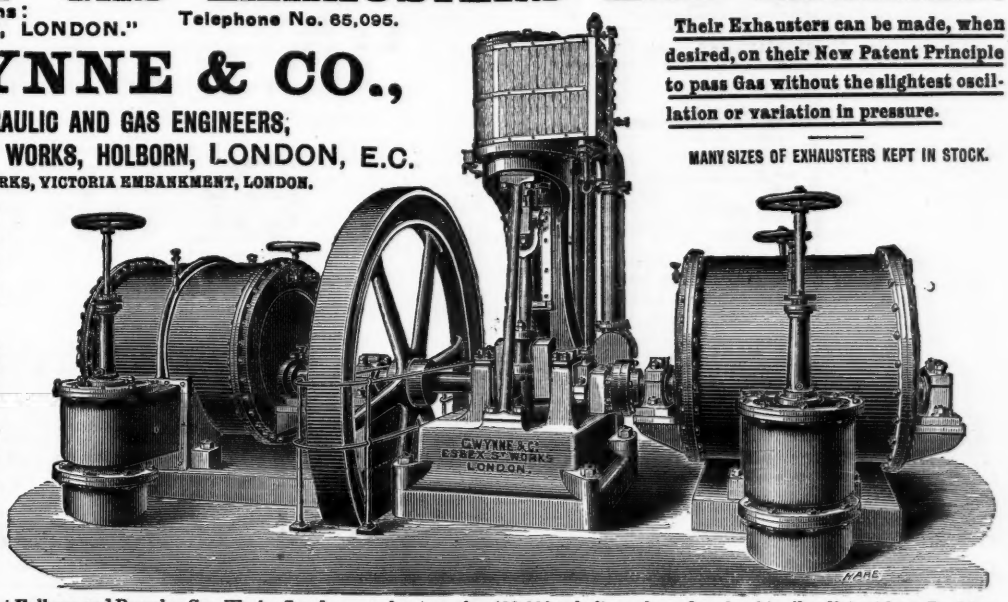

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, PATENT RETORT-LIDS, STEAM-PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

Exhausting Machinery at Fulham and Bromley Gas-Works, London—each set passing 400,000 cub. ft. per hour drawing 14 miles distant from Beckton.
Catalogues and Testimonials sent on application.

NOTICE TO ADVERTISERS.—COPY FOR ADVERTISEMENTS for the "JOURNAL" should be received at the Office *not later* than TWELVE O'CLOCK NOON ON MONDAY, to ensure insertion in the following day's issue.

Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS, should be received not later than the FIRST POST on SATURDAY.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.

JOHN WM. O'NEILL, Managing Director, Palmerston Buildings, Old Broad Street, London, E.C.

ANDREW STEPHENSON, AGENT. All communications re Oxide to be addressed to Palmerston Buildings.

WINKELMANN'S "VOLCANIC" CEMENT. Fire Resistance up to 4500° Fahr. In use in most Continental Gas-Works, and in more than 300 British Gas-Works.

ANDREW STEPHENSON,
182, GRESHAM HOUSE,
OLD BROAD STREET,
LONDON, E.C.

Telegrams: "*Volcanism, London.*"

AMMONIACAL LIQUOR Wanted.

BROTHERTON AND CO., Ammonia Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

GAS TAR Wanted.

BROTHERTON AND CO., Tar Distillers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SPENT OXIDE Wanted.

BROTHERTON AND CO., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

SULPHURIC ACID for Sale.

BROTHERTON AND CO., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

BROTHERTON & CO.

Offices: Commercial Buildings, LEEDS. Correspondence invited.

GOLD MEDAL, 1892.

TUBES and Fittings for Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.

JOHN SPENCER, Globe Tube Works, WEDNESBURY; and 14, Great St. Thomas Apostle, LONDON.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works Sundries. (See p. 1370, last week's issue.)

Telegrams: "HUTCHINSON BROS., BARNSLEY."

It is Worth Your While to Buy DIRECT.

THE RELIANCE LUBRICATING OIL COMPANY SUPPLY on APPROVAL "RELIANCE" NON-CORROSIVE LUBRICANTS (which, through their superiority, have the largest sale in the world)—viz., Engine, Cylinder, and Machinery Oils, 11½d.; Spindle Oil, 8½d.; Gas-Engine and Dynamo Oils, 1s. 6d. per gallon; Barrels Free and Carriage Paid. Also Liquids for Gas Making, Enriching, &c.

RELIANCE LUBRICATING OIL COMPANY, WATER LANE, GREAT TOWER, LONDON, E.C. Depôts at Liverpool, Bristol, Hull, Glasgow and Newcastle-on-Tyne. Telegrams: "Subastral, London."

WANTED, a Situation as Working MANAGER by a thoroughly experienced Man. Can take Meters, lay Mains and Services, fix Stoves and Meters, and do General Fitting. Age 31; Married. First-class References. At present Foreman.

Address E. VANSTONE, Gas-Works, Redhill, SURREY.

WANTED, by a competent man, a Situation as FITTER. Experienced in all branches of Gas-Fitting, fixing Meters, Heating or Cooking Stoves, Automatic Fittings, Main and Service laying, Index reading, and general routine of Gas-Works.

Address A. MARTIN, 57, Beaconsfield Road, WALTHAMSTOW.

WANTED, by a Gentleman who has a thorough practical knowledge of the Gas Trade, including Gas-Fittings, Lamps, Chandeliers, Gas-Stoves, Tubes and Fittings, Gas-Meters, together with all accessories, who served his apprenticeship in one of the principal Gas-Works in Great Britain, and has travelled for 20 years, an appointment to REPRESENT A GOOD HOUSE in any of the above Branches. Highest References.

Address No. 2673, care of Mr. King, 11, Bolt Court FLEET STREET, E.C.

TRAVELLER, energetic, required for North of England, to push first-class Meters of all descriptions. State Experience and References.

Address No. 2672, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

BOROUGH OF SOUTHPORT.
(GAS DEPARTMENT.)

WANTED, an outside Inspector who must be well experienced in the fixing of Meters, Service-Pipes, and Fittings. Wages 35s. per week.

Applications to be in the hands of the undersigned not later than July 10 next, accompanied by three References or *Copies* of Testimonials.

JOHN BOOTH,
Engineer.

Southport, June 25, 1896.

J. & J. BRADDOCK, Globe Meter Works, Oldham.

First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.

Telegraphic Address: "Braddock Oldham."

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from SULPHUR, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for, Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.

Telegraphic Address: "PORTER LINCOLN."

SADLER & Co., Ld., Middlesbrough; ULVERSTON (BARROW); PORTSMOUTH; CARLTON (N.E.R.); and STOCKTON. Tar and Petroleum Distillers. Benzol and Petroleum Spirit, 700 and other Gravities, specially prepared for Carburetting. SOLAR OIL for Gas Making Kerosene, &c.

Correspondence invited.

Telegraphic Address: "Sadler, Middlesbrough."

NEW GAS PLANT CEMENT.

JOHN E. WILLIAMS AND CO.,
VICTORIA PAINT WORKS,
MANCHESTER.

For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
For all Ammonia Joints.

SULPHATE OF AMMONIA SATURATORS.

WALTER THOMASON and SONS, Chemical Plumbers, &c., and Makers of Lead Saturators, &c., 21, WESTON STREET, BOLTON. Repairs of every description.

Please write for Estimate before ordering elsewhere.

PATENTS FOR INVENTIONS.

J. C. CHAPMAN, M.I.M.E. and Fel. Chartered Inst. Patent Agents. ADVICE ON ALL MATTERS CONNECTED WITH ABOVE. Information and Handbook on application.

70, CHANCERY LANE, LONDON, W.C.

HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.

Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.

READ HOLLIDAY AND SONS, LIMITED, HUDDERSFIELD.

WANTED, immediately, a steady trustworthy GAS-FITTER. One who has had experience in fitting up Houses, Pendants, Brackets, and Compo. Work, also Meters, Cooking Stoves, &c. State Wages, with *copy* of one Testimonial. Temperance man preferred.

Apply to GEORGE LANE, Gas-Works, AYLESBURY.

CITY OF BIRMINGHAM.
(GAS DEPARTMENT.)

APPLICATIONS are invited for the post of SUPERINTENDENT of the Windsor Street Works. Salary commencing at £250 per annum, with House on the Works, Coal, and Gas.

Also for that of SUPERINTENDENT of the Adderley Street Works (both posts being vacant). Salary commencing at £200 per annum, with House on the Works, Coal, and Gas.

Applications stating Age, Experience, and present Occupation, and enclosing *copies* of recent Testimonials, to be sent to the undersigned not later than July 4.

CHAS. HUNT,
Engineer.

Windsor Street Works, Birmingham.

COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

ANALYST.

THE Gas Committee are prepared to receive APPLICATIONS for the appointment of ANALYST at their Works. Salary £120 per annum.

Candidates must have had experience in a Gas-Works, and be able to test Gas for Illuminating Power and Impurities, and make all the Chemical Analyses required.

State Age and Experience, and enclose Testimonials from recent employers.

Applications, endorsed "Analyst," and addressed to the Chairman of the Gas Committee, Gas Offices, Bloom Street, Salford, to be delivered before Five p.m., on Wednesday, July 8, 1896.

By order,
SAM. BROWN,
Town Clerk.

Town Hall, Salford,
June 23, 1896.

GAS PURIFICATION.

OXIDE OF IRON BOG ORE.

BALE & CO.'S Oxide of uniform quality. Sample and Price on application.

OXIDE PAINTS, OILS, SULPHURIC ACID, &c.
120 and 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."

OXIDE OF IRON.

FINEST Quality of Natural Bog Ore. Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

SULPHATE OF AMMONIA SATURATORS.

JOSEPH TAYLOR & CO., Chemical Plumbers, &c., and Makers of every description of Solid Plate Lead and Timber Cased Saturators, &c. CENTRAL PLUMBING WORKS, TOWN HALL SQUARE, BOLTON. Special Attention to Repairs.

Before placing Orders, please write for Estimate.

CANNEL, COAL, ETC.

JOHN ROMANS & SON, EDINBURGH, Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS and WATER WORKS.

Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, / NEWTON GRANGE, NEWBATTLE, DALKEITH, } SCOTLAND.

TO EMPLOYERS, COMPANY DIRECTORS, ETC.

THE LAW GUARANTEE & TRUST SOCIETY, LD., GUARANTEES FIDELITY.

SEND for complete Prospectus containing Balance-Sheet, Copy of Policy, &c., &c. Mortgage, Debenture, License, and Contingency Insurance.

Head Office: 49, CHANCERY LANE, LONDON, W.C.

ECONOMY IN PURIFICATION.

INCREASE the Efficiency of your PURIFIERS by adopting CRIPPS'S PATENT BYE-PASS VALVE in the lower Tiers of Sieves. Practical Experience proves their Economy. Engineers are repeating orders after thorough trial.

References and Particulars can be obtained from the Makers—

C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP.

And J. EVERY & SON, Phœnix Iron-Works, LEWES.

WORKS CHEMIST.

YOUNG Man wanted. Preference given to one experienced in Gas Manufacture and Tar Distilling.

Apply, by letter, to No. 2671, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—Four Purifiers, 12 feet square, and 6 feet deep, with Walker's Dry-Faced Centre-Valve and 12-inch Connections.

For Price, &c., apply to W. WINSTANLEY, A.Inst.C.E., Engineer, Gas-Works, Newcastle, STAFFS.

FOR SALE — Retort Mouthpieces, ∩ 16 in. by 14 in., ovals, 21 in. by 15 in.; 5-inch H-PIPES and DIP-PIPES; ASHPANS; also RECIPROCATING EXHAUSTER, about 8000 cubic feet per hour.

HENRY TOBEY, Gas-Works, Malton, YORKS.

REDHILL GAS COMPANY.

RETORT-FITTINGS FOR SALE.

THE Directors have for disposal, in consequence of pulling down the Benches, the following RETORT-FITTINGS, all of which are in excellent condition, and can be inspected any time:—

Fifty 18-inch by 15-inch ∩ Cast-Iron MOUTHPIECES, with Wrought-Iron Lids, fitted with Swing Cross-Bars and Screws.
Seventy 4-inch Cast-Iron BRIDGE-PIPES.
Seventy 4-inch Cast-Iron DIP-PIPES.
And the necessary 6-inch to 4-inch taper ASCENSION-PIPES.

Any further Particulars may be had from the undersigned.

C. READ,
Manager, &c.

URBAN DISTRICT COUNCIL OF OLDBURY.
(GAS DEPARTMENT.)

THE Gas Committee of this Council are open to receive TENDERS for the supply of 8000 Tons—or thereabouts—of screened GAS COAL, for delivery during the Year ending the 31st of August, 1897, and a like quantity for delivery during the Year ending the 31st of August, 1898, in such quantities and at such times as ordered, carriage free, at the (1) Oldbury Basin G.W.R., and (2) L. & N.W.R., Oldbury.

The Coal must be of first-class quality, well screened, freshly wrought, and as free as possible from Bats, Pyrites, and other foreign matter.

Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Gas Coal," must be delivered to the undersigned not later than Saturday, July 11 next.

The Gas Committee do not bind themselves to accept the lowest or any tender, and reserve to themselves the right to apportion the whole quantity as they may think fit.

Tender Forms and any other Information may be obtained from the undersigned on application in writing.

By order,
A. COOKE,
General Manager.

Gas-Works, Oldbury,
June 27, 1896.

TENDERS FOR COAL.

THE Directors of the Tenterden Gas Company invite separate TENDERS for the supply of 500 Tons of best EAST PONTOP GAS COAL, delivered at Headcorn and Appledore Stations, S.E.R.—400 Tons to be delivered in July, August, and September; the remainder as, and when, required.

Sealed tenders, endorsed "Coal," to be sent to the Secretary, on or before July 13.

The Directors do not bind themselves to accept the lowest or any tender, or supply forms of tender.

W. T. MERCER,
Secretary.

Tenterden, June 27, 1896.

LOWESTOFT WATER, GAS, AND MARKET COMPANY.

TAR AND AMMONIACAL LIQUOR.

THE Directors of the Lowestoft Water, Gas, and Market Company invite TENDERS for the surplus TAR and the whole of the AMMONIACAL LIQUOR to be produced at their Works for the Year ending the 30th of June, 1897.

Further Particulars may be obtained on application to the undersigned, to whom sealed tenders (duly endorsed) must be delivered not later than Noon on Friday, the 10th of July next.

The Directors do not bind themselves to accept the highest or any tender.

JOHN AYRIS,
Manager.

Surrey Street, Norwich.

BRIERLEY HILL GAS COMPANY.

TENDERS FOR TAR.

THE Directors of the above Company are prepared to receive TENDERS for the surplus TAR made at their Brierley Hill and Kingswinford Works for One Year ending the 30th of June, 1897, delivered into Boats at the former place in one hour and at the latter in twelve hours.

Tenders to be addressed to the Chairman, and delivered not later than the 17th of July next.

The Directors do not bind themselves to accept the highest or any tender.

HENRY M. JACKSON.
Secretary.

Gas-Works, Brierley Hill,
June 20, 1896.

LONGFORD GAS COMPANY, LIMITED (IRELAND).

THE Directors invite Tenders for the supply of 500 to 600 Tons of best GAS COAL (Analysis to accompany each tender). Coal to be delivered free of all expense into Midland Great Western Railway Company's Waggons at Spencer Dock, Dublin.

Tenders will be considered on Friday, the 3rd day of July next, at Twelve o'clock noon, and should be endorsed "Tender for Gas Coal."

The Directors do not bind themselves to accept the lowest or any tender.

By order,
W. A. REID,
Secretary.

Gas Office, Longford,
June 25, 1896.

BOROUGH OF NELSON.

THE Gas Committee of the above Corporation invite TENDERS for the supply and delivery of CAST-IRON SOCKET and SPIGOT PIPES, 12 inches, 10 inches, 8 inches, and 6 inches diameter respectively.

Specification and all Particulars may be obtained from the Engineer and Manager, Mr. W. Foster.

Sealed tenders, endorsed "Cast-Iron Pipes," to be sent in to the undersigned, not later than Twelve o'clock noon on Monday, the 13th day of July, 1896.

The Gas Committee do not bind themselves to accept the lowest or any tender.

By order,
R. M. PRESCOTT,
Town Clerk.

Town Hall, Nelson,
June 23, 1896.

CITY OF HEREFORD.

THE Gas Management Committee of the Corporation invite TENDERS for the supply of best screened large GAS COAL for One Year, from the 1st of July next, to be delivered free at the Gas-Works Siding, Hereford, in such quantities as may be required from time to time.

The estimated quantity required will be about 6000 Tons.

Full Particulars and printed Forms of Tender may be obtained on application to the undersigned.

Tenders, endorsed "Tender for Gas Coal," are to be sent in addressed to the Chairman, Gas Management Committee, Mansion House, Hereford, by Saturday, July 4.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
WILLIAM PARLBY,
Gas Engineer and Manager.

Gas-Works, Hereford,
June 22, 1896.

THE GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to CAPITAL STOCK, WILL BE CLOSED at Four o'clock p.m., on Tuesday, the 7th day of July next, and will be RE-OPENED immediately after the Half-Yearly General Meeting of the Company, to be held on the 7th day of August next.

By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.

Chief Office: Horseferry Road,
Westminster, S.W., June 27, 1896.

RAMSGATE CORPORATION.

WATER-WORKS.

THE Council desire Tenders for new BUILDINGS, comprising Engine-House, Boiler-House, Workshop, Stores, and Offices, also Station Superintendent's House, to be erected at their Whitehall Station.

Drawings and Specification may be seen on application to William A. M'Intosh Valon, Engineer, at his Ramsgate Office, and copy of the Quantities obtained on depositing £3 3s., which will be returned on receipt by the Corporation of a *bond-fide* tender.

Tenders to be sent in not later than Ten a.m., on Monday, July 6, addressed to the Chairman of the Gas and Water Department, and endorsed "Water-Works New Buildings."

The Council do not bind themselves to accept the lowest or any tender.

W. A. HUBBARD,
Town Clerk.

MANUFACTURE AND SUPPLY OF GAS AT ATHLONE, BIRR, AND FERMOY.

THE Secretary of State for War is prepared to receive TENDERS for the MANUFACTURE and SUPPLY OF GAS at Athlone, Birr, and Fermoy, during the period of Six Years from the 1st of August, 1896.

The existing Gas-Works at the above-named Places may be inspected, and Printed Forms of Tender, and any further Information obtained, on application to the Assistant Adjutant General, Lower Castle Yard, Dublin, or to the Officer in charge at the Stations specified.

The Tenders are to be delivered at the Head-Quarter Office, Royal Barracks, Dublin, by Twelve o'clock Noon, on Wednesday, the 15th day of July, 1896, addressed to the General Officer Commanding, and marked on the outside "Tender for Manufacture of Gas."

A. MAJOR,
Director of Army Contracts.

War Office, Pall Mall, S.W.,
June, 1896.

PATENTS, DESIGNS, AND TRADE MARKS ACTS, 1883 to 1888.

NOTICE is Hereby Given, that the Incandescent Gas-Light Company, Limited, of 14, Palmer Street, Westminster, in the County of London, have applied for LEAVE TO AMEND THE SPECIFICATION of the Letters Patent No. 586, of 1891, granted to Ludwig Haitinger for "An Improved Manufacture of Incandescence Bodies for Incandescence Gas-Lamps."

Particulars of the proposed Amendments were set forth in the "Illustrated Official Journal (Patents)" issued on the 24th June, 1896.

Any person or persons may give notice of opposition to the Amendment (on Form G), at the Patent Office, 25, Southampton Buildings, London, W.C., within one Calendar Month from the date of the said "Journal."

(Signed) H. READER LACK,
Comptroller-General.

ABEL AND IMRAY,
Consulting Engineers and Chartered Patent Agents,
28, Southampton Buildings, London, W.C.,
Agents for the Applicants.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.

Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.

Offices: 18, FINSBURY CIRCUS, E.C.

BY ORDER OF THE DIRECTORS OF THE SOUTHEND GAS COMPANY.

SALE OF 400 SHARES.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Mart, London, E.C., on Monday, July 6, at Two o'clock, in lots varying from Five to Ten Shares in each lot, 400 £10 SHARES (fully paid) in the SOUTHEND GAS COMPANY, ranking for a Standard Dividend of 7 per cent.; the last Dividend on the same class of Shares having been at this rate.

Particulars of the SECRETARY, at the Offices, SOUTHEND; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For Prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.
B Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
165, QUEEN VICTORIA STREET, E.C.,
And at STROUD, GLOUCESTERSHIRE.

By order of the Directors.

TO TRUSTEES AND INVESTORS.

NOTICE OF SALE BY AUCTION BY

MESSRS. CRAWTER, at the Falcon Hotel, Waltham Cross, on Thursday, July 23, 1896, at Six for Seven o'clock precisely, of £3150 PERPETUAL 4 per cent. DEBENTURE STOCK of the Waltham Abbey and Cheshunt Gas and Coke Company.

The last Half-Yearly Dividends have been at the rate of 7 per cent. per annum on the Original Share Capital of the Company. The increase in the Consumption of Gas during the last Four Years amounts to 10 million cubic feet; and, as the neighbourhood is rapidly developing, a further increase of Consumption may confidently be anticipated.

Particulars may be obtained of the SECRETARY of the Company, Waltham Abbey, ESSEX; at the place of Sale; and of Messrs. CRAWTER, Land Agents and Auctioneers, Cheshunt, HERTS.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton .	10,500	Cubic Feet.
Illuminating Power .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For Prices, &c., apply to the

HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

All Sizes of Elevators and Conveyors of every class, for Coal, Coke, Mechanical Stoking, and all other purposes, made and erected by the NEW CONVEYOR COMPANY, LTD., Transport Appliance Works, SMETHWICK.

(ALL NEW PATTERNS)

BIRMINGHAM.

HUNTER'S

OXIDE OF IRON.

James Hunter, Miner, and Shipper of NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

5, PRINCES STREET, PORT GLASGOW.

Telegrams: "Hunter, Port Glasgow."

Established 1872.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

Latest Analysis—By Charles Phillips, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton. . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 108 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

Results of Different Analyses:—

Yield of Gas Per Ton. . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,

HOLMSIDE AND SOUTH MOOR OFFICES,

NEWCASTLE-UPON-TYNE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED,

— *v* —

"DE MARE" COMPANY.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

— *v.* —

"SUNLIGHT" COMPANY.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, HEREBY GIVE NOTICE, as follows:—

VALIDITY. The Company's Patent has been declared VALID ON ALL POINTS after a Fifteen-Day Trial.

NATURE OF INVENTION. The Invention was described by Mr. Justice Wills as a "PIONEER INVENTION."

SCOPE OF PATENT. The Patent HAS BEEN GIVEN A WIDE CONSTRUCTION; and it was held that the protection given by it was not confined to Mantles manufactured according to the particular prescriptions set out in the Specification.

SHAPE OF MANTLE. The Judge held that a Mantle, even if made in a different form or shape (such as the "De Mare" Fringe or Plume), IS STILL AN INFRINGEMENT of the "Welsbach" Patent.

"DE MARE" JUDGMENT. Judgment for an INJUNCTION, WITH FULL COSTS, has been given against the "De Mare" Incandescent Gas-Light System.

"SUNLIGHT" JUDGMENT. Judgment was given AGAINST the "Sunlight" Incandescent Gas-Lamp Company, Limited, on the question of the VALIDITY OF THE PLAINTIFFS' PATENT.

"SUNLIGHT" MANTLES. Last about 100 hours.

"WELSBACH" MANTLES. Last about 1000 hours.

"Sunlight" Mantles BURN DOUBLE THE GAS to produce the same candle power as the Incandescent Gas-Light Company's Mantles.

Users of "Sunlight" Mantles are applying to the Incandescent Gas-Light Company to REPLACE THEM BY THEIR OWN MANTLES.

WARNING. Users of the Incandescent Gas-Light Company's Mantles upon "Sunlight" Burners ARE INFRINGERS OF THE COMPANY'S PATENT, AND WILL BE AT ONCE PROCEEDED AGAINST.

COSTS. Certificates of the Validity of the Company's Patent have been granted both by Mr. Justice Romer and Mr. Justice Wills entitling the Company to Solicitor and Client Costs, which will, IN ALL CASES, BE RIGOROUSLY ENFORCED.

INFRINGERS. The Incandescent Gas-Light Company WILL TAKE PROCEEDINGS AGAINST ALL PERSONS INFRINGING THEIR PATENT, WHETHER MAKERS, WHOLESALE DEALERS, RETAILERS, or USERS.

Users of the Company's Mantles upon Burners not sold by the Company ARE INFRINGERS.

"LIMITED LICENSE" WARNING. Judgments have already been obtained against such users from Mr. Justice Chitty, Mr. Justice Stirling, Mr. Justice Kekewich, and Mr. Justice North.

FAITHFULL & OWEN,
11, Victoria Street,
Westminster.
Solicitors to the Incandescent Gas-Light Company, Limited.

April, 1896.

NOTICE.

The attention of the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, having been again called to the Advertisements inserted in various papers by the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, to the effect that the "Meteor" Incandescent Gas-Lights are an Infringement of their Patents, and that they will bring Actions for Infringement against all persons found dealing in any manner with such Lights, the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, HEREBY GIVE NOTICE that they are advised that the "Meteor" Incandescent Lights in no way infringe any of the Patents of the Incandescent Gas-Light Company, Limited, that an action has been commenced to restrain such threats, and that they are PREPARED TO FULLY INDEMNIFY ALL PURCHASERS, DEALERS, AGENTS, and USERS of their Lights against any Legal Proceedings on the part of the Incandescent Gas-Light Company, Limited.

WILSON, BRISTOWS, & CARPMAEL,
1, Copthall Buildings, London, E.C.,
Solicitors to the Meteor Incandescent Lighting Company, Limited, of 35, New Broad Street, London, E.C.

Nov. 30, 1895.

Fcap. 4to, Cloth, price 7s. 6d., post free.

Practical Photometry.

By William Joseph Dibdin, F.I.C., F.C.S.

London: Walter King, 11, Bolt Court, Fleet St., E.C.

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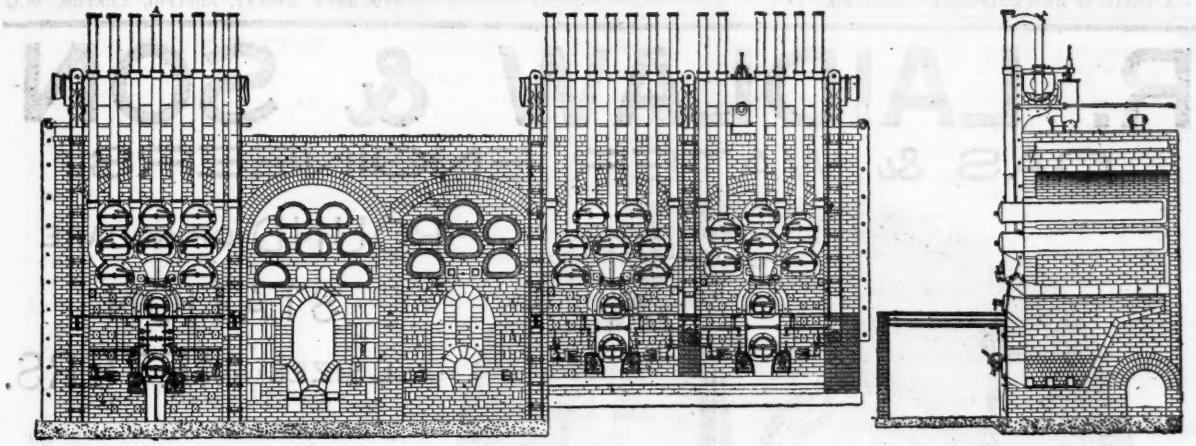
THE GRASSMOOR Co., Ld., CHESTERFIELD.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non.*
TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.
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Manufacture and keep in Stock at their Works
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ILLUMINATING POWER - 17·50 SPERM CANDLES.
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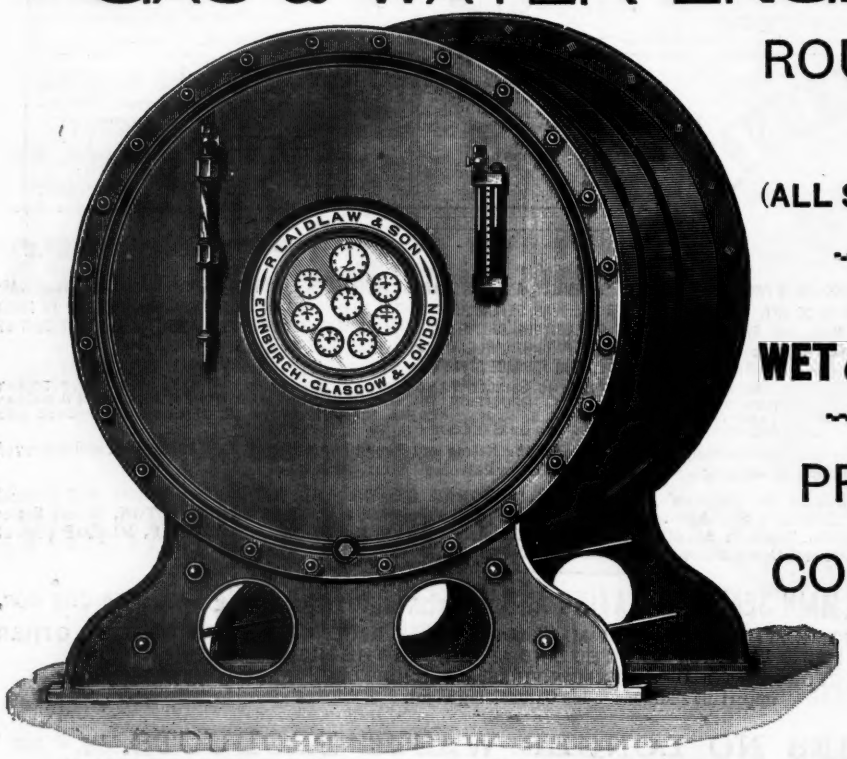

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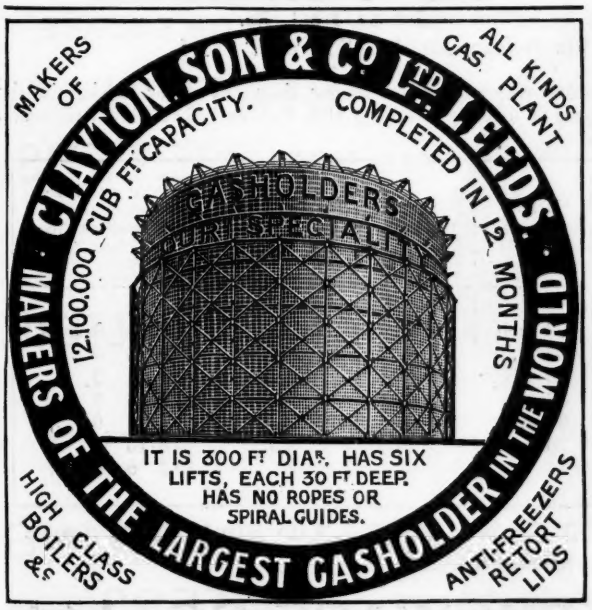
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[See Illustrated Advertisement, June 2, p. 1204.]

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IMPORTANT TO GAS COMPANIES.

This Gas-Cooker has met the demand of Gas Companies for a Cast-Iron Gas-Cooker with an interior of **PURE PORCELAIN ENAMEL.** This Cast-Iron Enamel is the result of a special process known as "Porceliron."

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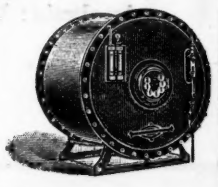

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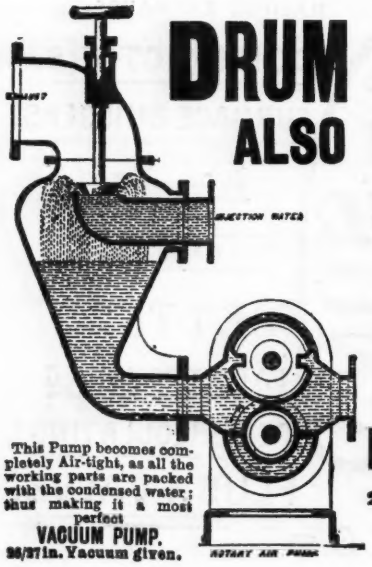
No Priming, Valves, or Frictional Working Parts.
The Pump of the future for quickly and economically moving large Bodies of Water, Semi-fluid, &c.

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26/27 in. Vacuum given.
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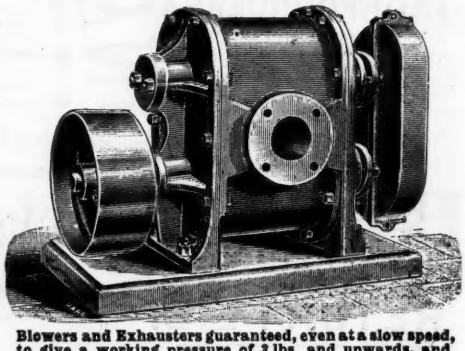
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The most successful and approved Apparatus known up to the present time.

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[See also Advt. p.1438.

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